

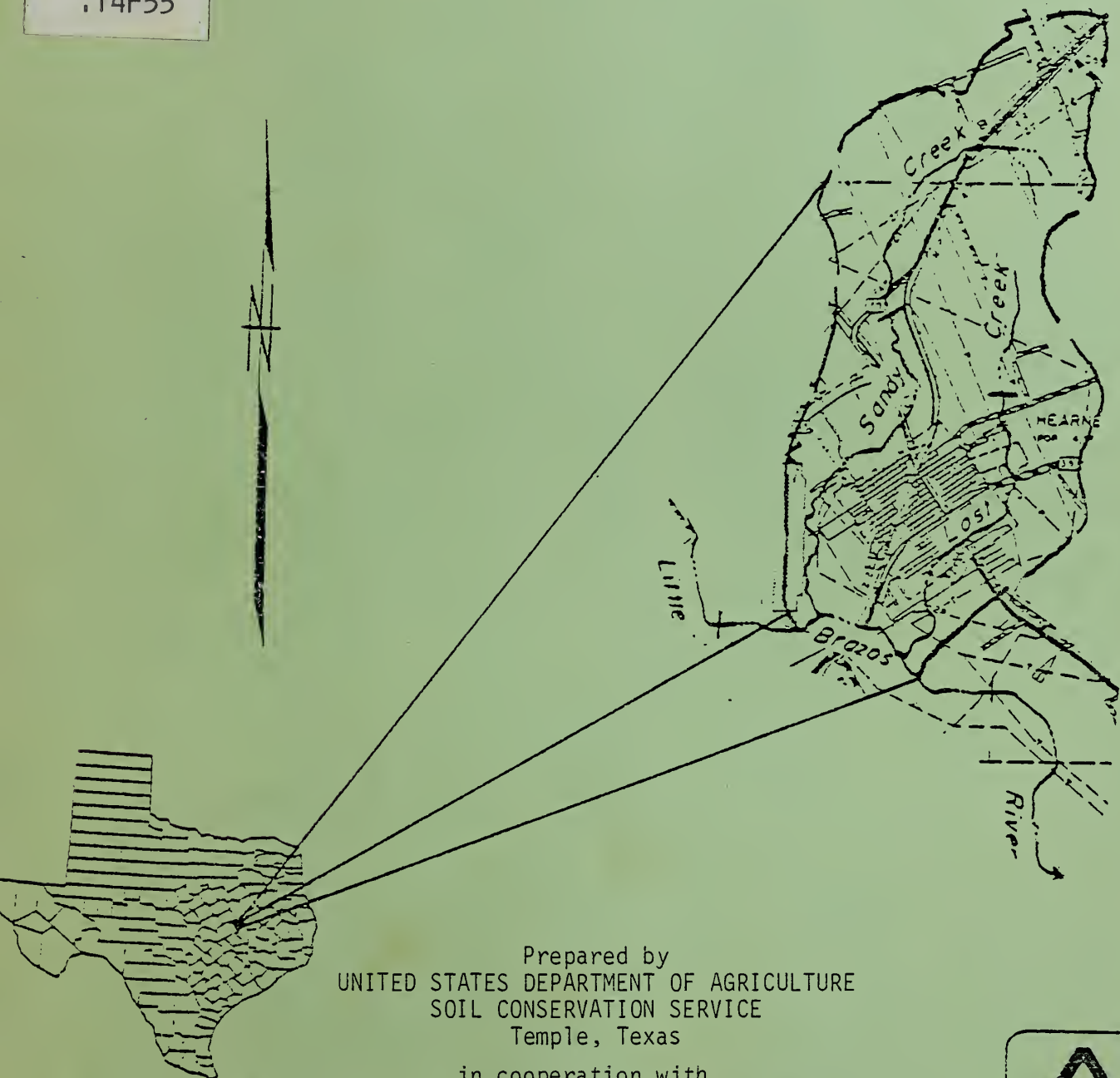
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LOST CREEK & SANDY CREEK FLOOD PLAIN MANAGEMENT STUDY

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ROBERTSON COUNTY, TEXAS



Prepared by
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Temple, Texas

in cooperation with
BRAZOS-ROBERTSON SOIL AND WATER CONSERVATION DISTRICT
CITY OF HEARNE
and the
TEXAS DEPARTMENT OF WATER RESOURCES



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February 1984

FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY, TEXAS

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INTRODUCTION

This flood plain management study report identifies areas of flood plain subject to flooding by Lost Creek and Sandy Creek within the City of Hearne and vicinity, Robertson County, Texas.

The assistance and cooperation given by the agenices, organizations and individuals during the Lost Creek and Sandy Creek Flood Plain Management Study is greatly appreciated. These include:

Brazos-Robertson Soil and Water Conservation District
City of Hearne

Special appreciation is extended to the individuals who contributed information for the study. Appreciation is also extended to the landowners who permitted access to their property for surveys, photographs, and reconnaissance.

In 1976 the Soil Conservation Service made a preliminary investigation of Lost Creek and Sandy Creek to determine the frequency and magnitude of flood damages to the City of Hearne. The SCS found during this investigation that annual flood damages are low, but the probable damage from a one percent chance or two percent chance flood event would be high. This investigation noted that severe flooding would probably occur in the flood plains of Lost Creek and Sandy Creek when the Little Brazos River is on the rise or at flood stage since it is the outlet for both Lost Creek and Sandy Creek. This investigation noted that detailed hydrologic and hydraulic studies would be required to detemine the

probable damages and flooded area from two percent chance or greater flood events and recommended that detailed hydrologic and hydraulic studies be made to determine the flood hazard from two percent chance or greater flood events.

The City of Hearne is presently in the emergency flood insurance program; however, no detailed flood insurance study has been made.

This cooperative study was requested by the City of Hearne, the Brazos-Robertson Soil and Water Conservation District and the Texas Department of Water Resources in order to obtain a factual basis for reducing future flood damages and flood hazards through carefully considered and well planned local regulations and use of the flood plain.

The study was conducted according to the May 1982 Plan of Work developed and endorsed by the above named requesting entities and the Soil Conservation Service.

The SCS conducts cooperative flood plain management studies in Texas through the November 1973 Joint Coordination Agreement (Revised 10/30/78) between the SCS and the Texas Department of Water Resources. SCS assists state agencies and communities in the development, revision, and implementation of their flood plain management programs by carrying out cooperative flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management," and Section 6 of Public Law 83-566. The principles contained in Executive Order 11988, Flood Plain Management, are addressed in this part.

Topographic data for this study were obtained from field surveys and Geological Survey topographic maps. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Peak discharge values were determined by flood routing various storm frequencies with a 24-hour rainfall duration using SCS Technical Release No. 20, A Computer Program for Project Formulation, Hydrology. Water surface profiles were developed by the Modified Slope Area Method using SCS Technical Release No. 61, WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates.

The computed flood elevations in this report are based on detailed studies of available basic data and use of recognized procedures for hydrologic investigations.

DESCRIPTION OF STUDY AREA

The study area includes Lost Creek, Sandy Creek and the reach of the Little Brazos River that affects the outlet of Lost Creek and Sandy Creek.

The study area is in Geological Survey Hydrologic Unit Number 12070101. The Lost Creek and Sandy Creek watershed is in the Water Resources Council Texas-Gulf Region, Subregion 07, and Brazos River Basin.

Lost Creek heads approximately 3.4 miles north of the Hearne city limits and flows in a southwesterly direction through the City of Hearne. It terminates at the Little Brazos River about 0.7 mile southeast of the Hearne city limits.

Sandy Creek heads approximately 4.9 miles north-northeast of the northeast corner of the Hearne city limits and flows in a southwesterly direction along the western edge of the Hearne city limits. It terminates at the Little Brazos River approximately 1.0 mile west-southwest of the southwest corner of the Hearne city limits. The Lost Creek watershed has a drainage area of 5.7 square miles or 3,642 acres. Sandy Creek watershed has a drainage area of 12.0 square miles or 7,684 acres. The Little Brazos River has a drainage area of 753.8 square miles or 482,433 acres. The total drainage area of the study area is 771.5 square miles or 493,759 acres (Index and Study Area Map, Appendix page 7).

The City of Hearne is the only community center in the study reaches of the watershed. The 1980 census gives the population of Hearne as 5,418.

The Index and Study Area Map, Appendix, page 7, shows the streams and areas that were studied. The total channel length of stream reaches that were studied in detail is 13.3 miles. This includes 4.2 miles on the flood plain of Lost Creek, 5.4 miles on Sandy Creek, and 3.7 miles on the Little Brazos River.

The Lost Creek and Sandy Creek watershed has a moist subhumid climate with moderate temperatures. The winters are mild with a January average minimum temperature of 40 degrees Fahrenheit. The July average maximum temperature is 96 degrees Fahrenheit. The mean annual rainfall is 35.8 inches with an irregular seasonal distribution. The average growing season is 268 days.

The Soils are of the Texas Claypan Land Resource Area. They have sandy surface layers over clayey subsoils. The land use in the watershed is primarily pastureland, rangeland and urban land. The pastureland and rangeland is used primarily for beef cattle production.

NATURAL VALUES

The Lost and Sandy Creeks watershed is located in the Post Oak Savannah Vegetational Area as discussed by F. W. Gould in Texas Plants -- A Checklist and Ecological Summary. This vegetational area is typified by both large areas of post oak trees and open areas. The open areas, historically were covered with native climax grasses such as little bluestem, Indiangrass, purple top, silver bluestem and Texas wintergrass. Early settlers converted most of the open land to cropland. Today most of this open land is in pastureland with cropland comprising less than one percent of the area. The present major land uses in the watershed include pastureland, open rangeland, wooded rangeland, and urban areas.

Open areas, which presently are in pastureland and rangeland comprise 49 percent of the watershed. Coastal bermuda is the dominant pastureland grass. The major grass found on the open rangeland today is Texas wintergrass. Various species of bluestem, lovegrass, panicum, paspalums and annual grasses and forbs are also present.

Wooded rangeland still covers a large portion of the study area. These wooded areas cover 31 percent of the watershed. Post oak and blackjack

are the principal upland tree species. Other species include winged elm, hackberry, osage orange and yaupon. The riparian woodlands contain blackwillow, cottonwood, cedar, elm and hackberry. Understory species include yaupon, hawthorns, greenbrier, grape and many other species.

The major and most important natural value of the Lost and Sandy Creek flood plain is its ability to transport floodwater.

PRIME FARMLAND SOILS

Prime farmland soils cover approximately seven percent of the watershed. The amount of prime farmland soils in the watershed is shown in Table 1.

TABLE 1
PRIME FARMLAND SOILS
LOST AND SANDY CREEKS FLOOD PLAIN MANAGEMENT STUDY

Watershed	Rural		Urban		Total Prime Farmland	
	Acres	Percent	Acres	Percent	Acres	Percent
Upland	320	71	290	85	610	77
Flood Plain* (500-year)	130	29	50	15	180	23
Total	450	100	340	100	790	100

* Flood plain identified in this study.

WETLANDS

The wetlands in the watershed are Type I (seasonally flooded hardwood basins or flats), Type II (inland fresh meadows) and Type V, (inland

open fresh meadows), as defined by the U. S. Fish and Wildlife Service Circular 39 (Shaw and Fredine, 1971).

Types I and II wetlands occur mainly along the lower portion of the watershed near the Brazos River. Type V wetland is comprised of farm ponds which have emergent aquatic vegetation along the edge. These occur throughout the watershed.

FISH AND WILDLIFE HABITAT

The fishery resources in the watershed are primarily farm ponds. The ponds normally average less than one acre in size. A number of these ponds have been stocked with either largemouth bass and sunfish or channel catfish. In some instances all three types are stocked. The only stream fishery in the watershed is the Brazos River and the backwater from the Brazos into its tributaries. A variety of fish occur here. These include the largemouth bass, channel catfish, bullhead catfish, flathead catfish, and numerous species of sunfish, minnows and rough fish.

Wildlife habitat in the watershed is a mixture of large blocks of woods (post oak-blackjack oak association) and open areas with the riparian woodlands traversing through these areas. The wooded areas along the flood plain provide protective travelways which link up the large wooded areas. This allows many wildlife species such as white-tailed deer, coyote, bobcat and others to move from one area to the next.

Game species found in the watershed are mourning dove, bobwhite quail and white-tailed deer. Also, limited numbers of waterfowl inhabit farm ponds in the watershed during their winter stay.

Predator species include coyotes, bobcat and various species of raptors. The principal furbearers in this area are raccoon, opossum, skunk, gray and red fox, mink, and beaver. Other species in the watershed are cottontail, swamp rabbit, jackrabbit and a large variety of songbirds and rodents.

THREATENED AND ENDANGERED SPECIES

This watershed is in the range of occurrence of two species, which have been designated by the U.S. Fish and Wildlife Service as being endangered. These are Artic peregrine falcon (Falco peregrinus tundrus) and whooping crane (Grus americana). These species are migatory and may migrate through the watershed.

FLOOD PROBLEMS

Floods from Lost Creek and Sandy Creek damage residences, businesses, other buildings, streets and highways in the City of Hearne. Approximately 152 buildings would be affected by the 500-year frequency flood. These 152 buildings with contents have an estimated value of \$14,422,200. Approximately 96 buildings would be affected by the 100-year flood. These 96 buildings with contents have an estimated value of \$7,710,900.

Potential flood heights for 100-year and 500-year floods photographed at various locations to illustrate the flood problems are shown on pages 9 and 10 (Figures 1 through 4).

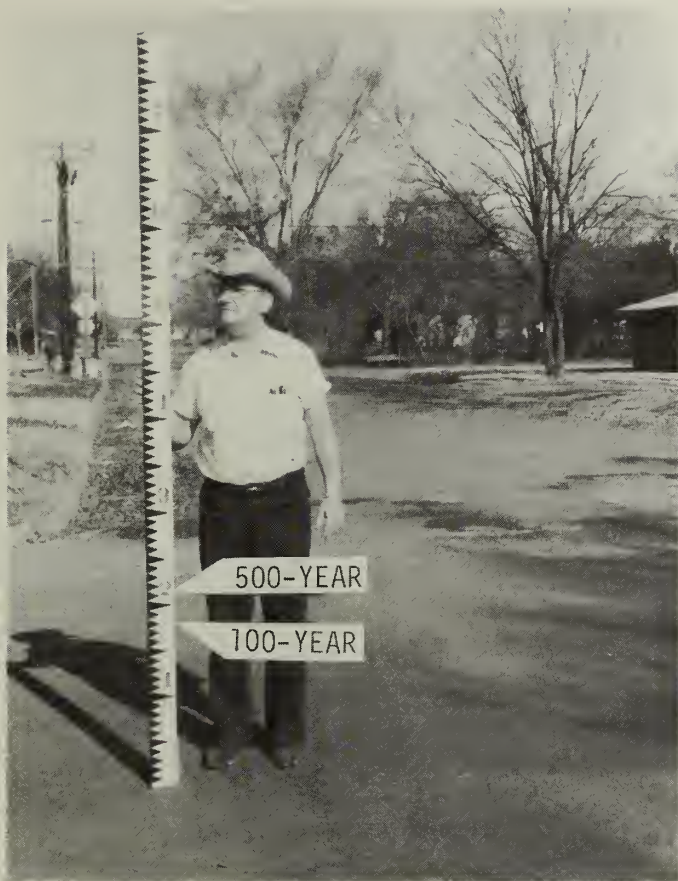


Figure 1 — Potential flood heights at cross section 19, Station 7710, Intersection of Anderson and Willow Streets approximately 550 feet northwest of Lost Creek.



Figure 2 — Potential flood heights at cross section 28, Station 9730, where San Gabriel Street crosses Lost Creek.



Figure 3 — Potential flood heights at cross section 41, station 7040, Crennan Lane Bridge on Sandy Creek Near Hearne Municipal Airport.



Figure 4 — Potential flood heights at cross section 50, Station 18670, on bridge where State Highway 6 crosses Sandy Creek.

Tabulated below are the acreages of rural and urban areas subject to inundation by the 100-year and 500-year floods.

LOST CREEK AND SANDY CREEK
FLOODED AREAS

	<u>Rural (Acres)</u>	<u>Urban (Acres)</u>	<u>Total (Acres)</u>
Within the 100-year Frequency flood plain	1087	476	1563
Within the 500-year frequency flood plain	1208	536	1744

Most of the expected flood damage occurs in the Lost Creek flood plain. The potential flooding from the 500-year (0.2 percent chance) flood or the 100-year (1 percent chance) flood will affect a wide area of the southeast portion of the City of Hearne along Lost Creek. Although the floodwaters cover a large area, they are fairly shallow, being 2.5 feet deep or less in most instances. This means many buildings not actually flooded will be surrounded by floodwater and the streets will be impassable to ordinary vehicle traffic.

Upstream flood plain and watershed land use changes anticipated by local officials within the next 10 to 15 years are not expected to significantly affect future flood elevations on the flood plains of the Lost Creek and Sandy Creek study area.

EXISTING FLOOD PLAIN MANAGEMENT

The 61st Texas Legislature in 1969 enacted the Texas Flood Control and Insurance Act, Article 8280-13 VACS, and Article 1581e-1 VACS. Article 8280-13 named the Texas Water Development Board and the State Board of Insurance as the responsible state-level agencies in respect to the National Flood Insurance Program. In 1977, the 65th Texas Legislature merged the state's three existing water agencies into the Texas Department of Water Resources. Article 8280-13 was codified in the Texas Water Code (Subchapter I, Section 16.311), and responsibility for the flood insurance program in Texas was assigned to the Texas Department of Water Resources and the State Board of Insurance. Subchapter I, Section 16.315 of the Code authorizes all political subdivisions, including cities, counties, and many types of special purpose districts and authorities, to take all necessary and reasonable actions to comply with the requirements and criteria of the National Flood Insurance Program.

At the present time, state-level statutory controls on use and management of flood hazard areas are fairly limited. Subchapter G, Section 16.238 of the Texas Water Code requires the Texas Department of Water Resources to approve plans for any levee or other such improvement which may change floodflows of any stream in Texas that is subject to floods. Also, in December 1977, Governor Briscoe issued Executive Order No. 34-A calling for state agencies to implement a flood plain management program for state-owned property and facilities. This state program will utilize state agency rules and regulations calling for evaluation of flood hazards and will conform

to the minimum flood plain management criteria established by the U. S. Department of Housing and Urban Development for the National Flood Insurance Program.

The City of Hearne is presently in the emergency flood insurance program.

ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT

PRESENT CONDITIONS

Very little development has occurred in the Sandy Creek flood plain. However, the flood plain of Lost Creek is highly developed. Residences, businesses and public buildings are presently located within the Lost Creek flood plain and additional development is underway. The Federal Insurance Administration published a Flood Hazard Boundary Map, effective March 29, 1974. This map was developed using approximate methods and does not show flood elevations. Flood elevations are necessary in order to set first floor elevations for new construction high enough to reduce damage from potential floods.

The City of Hearne has recently cut and removed brush, trees and other debris from the Lost Creek channel in order to improve the channel flow characteristics. This type of maintenance is necessary to maintain the carrying capacity of the channel.

LAND TREATMENT

Effective conservation land treatment is presently being carried out by landowners and operators in the watershed. Excess runoff or erosion and

sedimentation due to lack of conservation land treatment is not a major cause of Lost Creek and Sandy Creek flooding.

PRESERVATION AND RESTORATION OF NATURAL VALUES

Since the primary natural value of the Lost Creek and Sandy Creek flood plain is its ability to transport floodwaters, encroachment onto the flood hazard areas of the flood plain with obstacles which interfere with the movement of floodwater should be avoided to preserve its present carrying capacity.

The woody areas along the streambanks in the Lost Creek and Sandy Creek flood plain are considered important environmental corridors and wildlife habitat. Provisions should be made to protect these woody areas in the planning and development of new urban areas.

There is an excellent opportunity to use nonprime farmland soils for construction sites and other non-farm uses in order to preserve prime farmland since ample non-prime farmland soils are available in the watershed. Information on prime farmland soils in the study area may be obtained from the Soil Conservation Service office at Franklin, Texas.

NONSTRUCTURAL MEASURES

Nonstructural measures which will help reduce or minimize flood losses include flood proofing, flood warning systems, relocation, zoning regulations, participation in the national flood insurance program, emergency preparedness, and building or development codes.

Flood proofing can reduce flood damages by a combination of structural provisions and changes or adjustments to properties subject to flooding.

Examples of flood proofing are sealing low window and door openings and modifying floor drains to prevent the entrance of flood waters.

Flood warning systems should be coordinated with local disaster plans.

The National Weather Service issues warnings of potential flood producing storms. Staff gages set at key locations can be monitored to give advance warnings. A float-activated electronic signal could be connected to the local police or fire station for monitoring.

Relocation involves permanent evacuation of developed areas subject to inundation, acquisition of lands by purchase, removal of improvements and relocation of the population from such areas. Such lands could be used for parks or other purposes that would not suffer large flood damages and would not interfere with floodflows.

Zoning is a legal method used to implement and enforce the details of the flood plain management program, to preserve property values, and to achieve the most appropriate and beneficial use of available land. Clear, concise, and thorough zoning bylaws with enforcement of the bylaws are essential to make zoning effective.

Flood insurance was established by the National Flood Insurance Act of 1968 (Public Law 90-448, as amended) to make limited amounts of flood insurance, which were previously unavailable from private insurers, available to property owners and occupiers. The Flood Disaster Protection Act of 1973 (Public Law 93-234, as amended) was a major expansion of the National Flood Insurance Program.

Flood insurance is available through local insurance agents and brokers only after a local governing body applies and is declared eligible for the program by the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA). Adoption and enforcement of a local flood prevention ordinance which meets FEMA minimum flood plain management criteria is necessary to qualify and maintain eligibility.

In those communities participating in the FEMA program, owners and occupiers of all buildings and mobile homes in the entire community are eligible to obtain flood insurance coverage. Where flood insurance is available, it is recommended that buildings and mobile homes within or adjacent to the delineated flood hazard areas carry flood insurance on the structure and contents.

The City of Hearne is presently participating in the National Flood Insurance Emergency Program.

Emergency preparedness consists of a plan by local officials to be put into effect in the event of flooding. Procedures are worked out and personnel designated to implement the plan. Methods and procedures to alert and warn the populace of possible flooding are developed. High risk areas, handicapped, elderly or others known to need help during evacuation are located and identified. Plans are made for their evacuation or rescue. Shelters are provided for evacuees.

Building codes are developed to set up minimum standards for controlling the design, construction, and quality of materials used in buildings and structures

within a given area to provide safety for life, health, property and public welfare. Building codes can be used to minimize structural and subsequent damages resulting from inundation. Building restriction codes can:

1. Specify adequate anchorage to prevent flotation of buildings from their foundations.
2. Establish basement elevations and minimum first-floor elevations in accordance with potential flood heights.
3. Prevent virtually all damage by elevating the foundation and prohibiting basements in those areas subject to very shallow and frequent flooding.
4. Require building reinforcement to withstand water pressure or high velocity flow and restrict the use of materials which deteriorate rapidly in the presence of water.
5. Prohibit equipment that might be hazardous to life when submerged. This includes chemical storage, boilers, and electrical equipment.

Development policies which are designed to prevent construction of streets and utility systems in flood prone areas tend to slow development of the flood plains.

STRUCTURAL MEASURES

Structural measures such as dams or channels were considered as a means of reducing flood losses. Channels do not appear to be a viable

alternative due to site conditions and existing construction. A dam to check the uncontrolled flow of floodwater was examined as an alternative.

A site for a floodwater retarding dam located on Lost Creek immediately above the city park and golf course (cross section No. 34) which would control 51 percent of the drainage area upstream from Willow Street (cross section No. 19) was located. It does not appear that construction of the floodwater retarding structure at this site would be economically feasible. However, more detailed investigations will need to be made to verify its economic feasibility.

The proposed structural alternative will affect 140 acres at its emergency spillway crest. Of this, 70 acres is open habitat, 69 acres is woody habitat and the remaining one acre is roads.

The impacts from this structural measure will convert 15 acres of open habitat and 15 acres of woody habitat to water. Also the construction of the dam and spillway will destroy the existing habitat at its location. This will result in the loss of the wildlife species inhabiting these areas.

The proposed structure will not affect any wetlands, endangered species or prime farmland soils.

The City of Hearne and the Brazos-Robertson Soil and Water Conservation District will request that the Soil Conservation Service do a pre-application study of the floodwater retarding dam on Lost Creek to determine its feasibility for a PL-566 watershed project.

SELECTED ALTERNATIVE

The alternative for reducing flood losses selected by the City of Hearne for immediate implementation is to contact the Federal Insurance and Hazard Mitigation Division of the Federal Emergency Management Agency (FEMA) and apply for inclusion in the Regular National Flood Insurance Program. The City will adopt and implement the flood plain management ordinances necessary to qualify for and maintain eligibility in the Regular National Flood Insurance Program.

Other alternatives listed in this report will be considered for later implementation.

FLOOD HAZARD MAPS

The index map (Appendix, page 7) shows the stream reach covered by each of the photomaps. The index map also shows the watershed boundaries and stream reaches studied.

The limits of the 100-year and 500-year frequency floods, for present conditions, were delineated on aerial photographs (Appendix, pages 9 to 37) to indicate the extent of area inundated. The 10-year and 50-year frequency floods for present conditions could not be effectively shown on the aerial photographs due to the map scale and topography. The flood lines shown are based on field surveys of roads, bridges, and valley sections used in conjunction with Geological Survey topographic maps having 10-foot contour intervals, and interpretation of aerial photographs. These maps should only be used to determine the approximate boundaries of the

flood areas. Actual dimensions measured on the ground may vary slightly from those measured on the photomaps of this report due to map scale and reproduction limitations. The water surface profile elevations should be used to determine actual on the ground dimensions.

Flood elevations in this report are minimum elevations. Debris may collect at bridges and culverts and clog the channels during major floods and increase the depth of flooding. Analyses were made without showing the effects of potential obstructions. Also, extremely rare events such as catastrophic storms were not analyzed.

TECHNICAL APPENDIX

A technical appendix is included in this report. The index map, flood hazard area photomaps and flood profiles are included in the Appendix. The index map shows the study area coverage of individual flood hazard area maps and the watershed boundaries (Appendix, page 7).

The water surface profiles of Lost Creek and Sandy Creek show the profiles of the 10-year, 50-year, 100-year and 500-year frequency floods for present conditions. Included on the profiles are stream elevations of the channel bottom, pertinent bridge and roadway data, and other location data. The stationing of profile is bank full stream channel distance in feet and is based on measured distances from the 1972 flight of aerial photomaps. Flood depths can be estimated at any location on the stream reach from the water surface profiles. The water surface profiles are included in the Appendix, pages 39 to 67. They consist of Little Brazos River,

pages 39 to 45; Lost Creek, pages 47 to 55; and Sandy Creek, pages 57 to 67. An index is included in the Appendix pages 5 to 6, to assist the user relate the flood hazard area photomaps to the appropriate water surface profile.

Cross sections, representative of the streams studied, have been plotted to illustrate the shape of that stream and its flood plain. The 10-year, 50-year, 100-year, and 500-year floodwater surface elevations are shown on the plotted cross section to illustrate the effect of various flood depths (see Appendix, page 69).

The elevations, discharges and flood plain width of the 10-year, 50-year, 100-year and 500-year floods at surveyed cross sections are shown in Appendix Table 2. Each cross section is listed by number on this table. Each cross section is also identified by number on the flood hazard area photomaps. The user can locate a cross section on the photomap, turn to Table 2, (Appendix, pages 71 to 73) and read the discharge, elevation, and flood plain width directly from the table.

Also, included in the Appendix is a list of elevation reference marks showing the elevation and location of each. Additional data are on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

GLOSSARY

Channel -- A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channel Bottom -- The elevation of the deepest part of a stream channel at a particular cross section.

Flood -- An overflow or inundation that comes from a river or other body of water and causes or threatens damage.

Flood Frequency -- A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative stream flow or rainfall and runoff records. A 10-year frequency flood would have an average frequency of occurrence in the order of once in 10 years (a ten percent chance of being equalled or exceeded in any given year). A 50-year frequency flood would have an average frequency of occurrence in the order of once in 50 years (a two percent chance of being equalled or exceeded in any given year). A 100-year frequency flood would have an average frequency of occurrence in the order of once in 100 years (a one percent chance of being equalled or exceeded in any given year). A 500-year frequency flood would have an average frequency of occurrence in the order of once in 500 years (a 0.2 percent chance of being equalled or exceeded in any given year).

Flood Peak -- The highest value of the stage or discharge attained by a flood, thus, peak stage or peak discharge.

Flood Plain -- 1. Nearly level land situated on either or both sides of a channel which is subject to overflow flooding. 2. Lowland and relatively flat alluvial areas adjoining inland and coastal waters (streams, bays, etc.), including flood-prone areas of offshore islands.

500-Year Flood Plain -- The land that would be flooded on an average of once every 500 years.

100-Year Flood Plain -- The land that would be flooded on an average of once every 100 years.

Flood Profile -- A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage -- The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured.

High Water Mark (HWM) -- The maximum observed and recorded height or elevation that floodwater reaches during a storm, usually associated with the flood peak. The high water mark may be referenced to a particular building, bridge, or other landmark, or based on debris deposits on bridges, fences, or other evidence of the flood.

Low Bank -- The highest elevation of a specific channel cross section at which the water will be contained without overflowing onto adjacent flood plain areas.

Runoff -- That portion of the precipitation on a drainage area that is discharged from the area in stream channels; types include surface runoff, groundwater runoff, or seepage.

Structural Bottom of Opening -- The lowest point of a culvert or bridge opening with a constructed bottom through which a stream flows that could tend to limit the stream channel bottom to that specific elevation. This structural bottom may be covered with sediment or debris which further restricts the size of the opening.

Top of Opening -- The lowest point of a bridge, culvert, or other structure over a river, stream or watercourse that limits the height of the opening through which water flows. This is referred to as "low steel" or "low chord" in some regions.

Water Surface Profile -- A graph showing the relationship of water surface elevation to stream channel location for a specific flood event.

Watershed -- All land and water within the confines of a drainage divide.

Watershed Boundary -- The divide separating one drainage basin from another.

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TECHNICAL APPENDIX

APPENDIX

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ELEVATION REFERENCE MARKS	74

TECHNICAL APPENDIX

This Technical Appendix to the Lost Creek and Sandy Creek Flood Plain Management Study Report is a compilation of the FPMS technical findings. It includes the photomap index, flood hazard area photomaps, flood profiles, plottings of typical stream cross sections, elevation and discharge tabulations and a listing of pertinent elevation reference marks. Other technical data developed during this study is on file in the USDA Soil Conservation Service State Office, W.R. Poage Federal Building, 101 South Main Street, Temple, Texas 76501-7682.

INVESTIGATIONS AND ANALYSES

FIELD SURVEYS

Topographic data were obtained from Geological Survey topographic maps and field surveys. Engineering surveys were made of cross sections selected to represent the stream hydraulics and flood plain areas (refer to the sheets of typical valley cross section, Appendix, page 69). Elevations appearing in this report are based on mean National Geodetic Vertical Datum of 1929. Temporary elevation reference marks were established by Robert M. Eastwood, Registered Public Surveyor, in 1982-1983. Table 3 Appendix, pages 74 to 81, shows the listings, descriptions, and location of permanent and temporary elevation reference marks.

HYDROLOGIC AND HYDRAULIC METHODS

The Lost Creek and Sandy Creek watershed boundaries were determined by use of Geological Survey topographic maps. The top of the watershed begins

approximately 4.9 miles north-northeast of the Hearne city limits in Robertson County. Hydraulic evaluations were based on synthetic frequency methods. Rainfall frequency data were obtained from Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States. Values greater than the 100-year frequency event were determined by extrapolation of the rainfall versus frequency graph. Peak discharge values were determined by flood routing various storm frequencies with a 24-hour rainfall duration using SCS Technical Release No. 20, A Computer Program for Project Formulation, Hydrology. The program computes surface runoff resulting from any synthetic or natural rainstorm. The program will route the flow through stream channels and reservoirs. Results include, but are not limited to, a combination of the routed hydrograph with those from other tributaries and a printout of the peak discharges, their time of occurrence, and the water surface elevations for each computed discharge at any desired cross section or structure.

Geological Survey Water Resources Investigations 77-110 Open File Report "Technique for Estimating the Magnitude and Frequency of Floods in Texas" was used to develop peak discharges for comparison purposes only since it has no procedure for evaluating the effects of watershed structural improvements.

From the representative stream and road cross sections, water surface profiles were developed by the Modified Slope Area Method. The effects of bridges and culverts on the stream hydraulics were determined by use of the Bureau of Public Roads(BPR) Method. Computations were made using SCS's "WSP2, A Computer Program for Determining Flood Elevations and Flood Areas for Certain Flow Rates."

Using the output data from this program, rating curves were plotted for each cross section. These curves show the relationship between stage or elevation and discharge. Water surface profiles were developed from these rating curves and the computer results of TR-20 routings.

FLOOD HAZARD EVALUATION

The 500-year and 100-year frequency flood hazard areas are outlined on aerial photographs obtained from the April 1974 Agricultural Conservation and Stabilization Service flight. The flood hazard area boundaries were developed by plotting the computed water surface elevations on the surveyed cross sections and transposing this information to the aerial photographs. The flood hazard areas between the surveyed cross sections were developed through interpretation of Geological Survey topographic maps and the aerial photographs in conjunction with the surveyed cross sections. Actual flood limits may vary slightly on the ground from the outlined area on the photomaps due to map scale and reproduction limitations. For this reason, the water surface elevations from the flood profiles should be used for determining site specific potential flood depths.

ESTIMATES OF FLOOD LOSSES

The Urban Floodwater Damage Economic Evaluation computer application program (URB1) was used to compute average annual damages to buildings and contents. The program requires as input data percent damage factors (COF-DAMG) by flood depth for buildings and contents of representative houses or other types of buildings.

The URB1 computer application program locates each house to be evaluated, between cross sections, by means of stationing along a common base line and by

elevations at which damage begins. The damage to each house, or other type of building, is computed based on the frequency and depth of floods related to the damage factors for the type of house involved. Damages and benefits are summarized for each cross section for each reach and alternative.

INVENTORY OF NATURAL VALUES

The natural values of the Lost Creek and Sandy Creek flood plain were determined by the Soil Conservation Service staff biologist through on the ground reconnaissance, interviews of local people and literature search.

PUBLIC PARTICIPATION

The Lost Creek and Sandy Creek Flood Plain Management Study Plan of Work was developed through consultation with the local officials and study endorsers.

A public meeting was held during preparation of the report draft in order to get public input and participation.

MANAGEMENT ALTERNATIVES

Nonstructural management alternatives were considered during the flood plain management study and discussed during meetings with local public officials and other interested members of the public. Those considered to have merit and worthy of further study for possible implementation were put in the report.

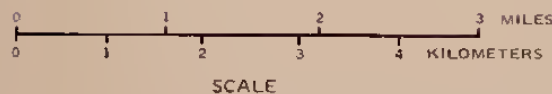
A structural measure consisting of a floodwater retarding dam was studied to determine its effect on flooding and the feasibility of construction. Detailed studies were not made, but cost estimates were developed. If this alternative is selected, additional detailed investigations and planning will be needed in order to implement this alternative.

INDEX
TO
LOST CREEK AND SANDY CREEK FLOOD PLAIN MANAGEMENT STUDY
FLOOD HAZARD AREA PHOTOMAPS
AND
WATER SURFACE PROFILES

Cross Section Number	Flood Hazard Area Photomap Page Number	Water Surface Profile Page Number	Cross Section Number	Flood Hazard Area Photomap Page Number	Water Surface Profile Page Number
LITTLE BRAZOS RIVER			LOST CREEK (Cont'd)		
1	9, 19	41	18	11, 13, 23	49
2	19, 21	41	19	11, 13, 23	49
3	19, 21	41	20	13	49
4	19, 21	41	21	13	49
5	19, 21	41, 43	22	13	49
6	19, 21	43	23	13	49
7	19, 21	43	24	13	49
8	19, 21	43	25	13	49
9	19, 21	43	26	13	49
10	19, 21, 23	43	27	13, 15	49
11	33	45	28	13, 15	49
LOST CREEK			29	13, 15	49
12	9, 11, 19, 21	47	30	13, 15	51
13	11, 21	47	31	15	51
14	11, 21	47	32	15	51
15	11, 21	47	33	15	51
16	11, 13, 23	49	34	15, 17	53
17	11, 13, 23	49	35	17	55

INDEX
TO
LOST CREEK AND SANDY CREEK FLOOD PLAIN MANAGEMENT STUDY
FLOOD HAZARD AREA PHOTOMAPS
AND
WATER SURFACE PROFILES

Cross Section Number	Flood Hazard Area Photomap Page Number	Water Surface Profile Page Number	Cross Section Number	Flood Hazard Area Photomap Page Number	Water Surface Profile Page Number
LOST CREEK (Cont'd)			SANDY CREEK (Cont'd)		
36	17	55	52	25, 27	63
37	17	55	53	25, 27	63
38	17	55	54	27, 29	65
SANDY CREEK			55	31	67
39	21, 33	57			
40	23,25,35,37	59			
41	23,25,35,37	59			
42	23,25,35,37	59			
43	25, 37	61			
44	25, 27	61			
45	25, 27	61			
46	25, 27	61			
47	25, 27	61			
48	25, 27	63			
49	25, 27	63			
50	25, 27	63			
51	25, 27	63			



LOCATION IN TEXAS



LEGEND

- County Line
- Railroad
- Divided Highway
- State Highway
- Farm to Market Road
- Watershed Boundary
- Stream Channel Study Reach
- Photomap Coverage

INDEX MAP FLOOD PLAIN MANAGEMENT STUDY AREA

LOST CREEK & SANDY CREEK ROBERTSON COUNTY, TEXAS

SOURCE: COUNTY HIGHWAY MAP
 POLYCONIC PROJECTION NORTH AMERICAN DATUM
 Control: U.S. Coast and Geodetic Survey and U.S. Geological Survey
 Compiled from USGS quadrangles and updated with aerial photographs
 Compiled: 1971 Field Checked 1971 Photographs: 1967

JOIN SHEET 1

JOIN SHEET 7

5000

4000

3000

2000

1000

STUDY LIMIT

1

RM 21X

12

RM 13X

CITY LIMIT

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground.



ASCS Photography 4-74



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LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



JOIN SHEET 7

12

2000

3000

4000

5000

6000

15

17

18

19

13

14

HEARNE CITY LIMIT

HEARNE CITY LIMIT

SH 6

SP RR

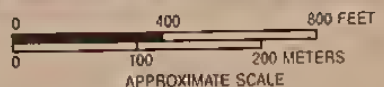
LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground.



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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS**

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK

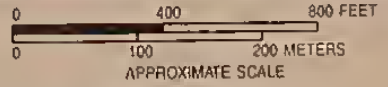
SHEET 2011 5



LEGEND

- | | |
|----------------------------|---------------------------|
| 100 Year Flood Hazard Area | Cross Section Location |
| 500 Year Flood Hazard Area | Stream Channel |
| | Elevation Reference Marks |

1400 ———> Channel Station
Limits of flooding may vary from actual location on the ground.



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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK

SHEET 3 OF 5



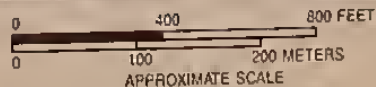
LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground.



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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground.

0 400 800 FEET
0 100 200 METERS
APPROXIMATE SCALE

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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS**

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



LEGEND

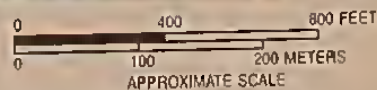
- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area



- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground.



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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS**

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



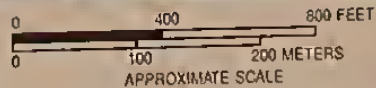
LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground.



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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area



Cross Section Location

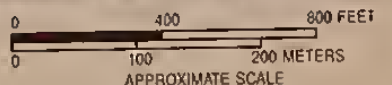
Stream Channel



Elevation Reference Marks

1400 Channel Station

Limits of flooding may vary from actual location on the ground.



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SHEET 8 OF 15



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LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area

Cross Section Location
Stream Channel
Elevation Reference Marks

1400 Channel Station

Limits of flooding may vary from actual location on the ground.

0 400 800 FEET
0 100 200 METERS
APPROXIMATE SCALE

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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



LEGEND

100 Year Flood Hazard Area
500 Year Flood Hazard Area

Cross Section Location
Stream Channel
Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground.

0 400 800 FEET
0 100 200 METERS
APPROXIMATE SCALE

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ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK



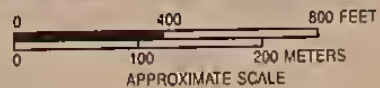
LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 ———> Channel Station

Limits of flooding may vary from actual location on the ground.



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LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK

SH 8
SP RR

55

STUDY LIMIT

RM 48
55

HWY 79
MPRR

BM 5

JOIN SHEET 11

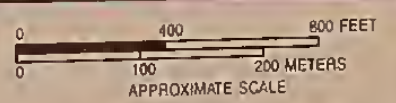
LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 Channel Station

Limits of flooding may vary from actual location on the ground



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LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK

SHEET 12 of 15



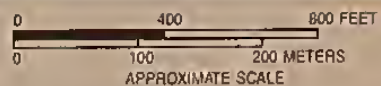
LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 — Channel Station

Limits of flooding may vary from actual location on the ground,



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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK

STUDY LIMIT



HEARNE MUNICIPAL AIRPORT

40 41 42

RM 25

RM 30

3000

4000

6000

6000

7000

8000

JOIN SHEET 8

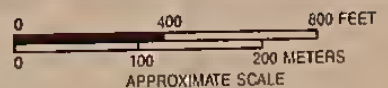
JOIN SHEET 15

JOIN SHEET 13

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

- 1400 Channel Station
- Limits of flooding may vary from actual location on the ground.



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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK

SHEET 14 OF 15



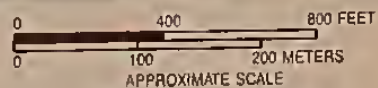
LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area

- Cross Section Location
- Stream Channel
- Elevation Reference Marks

1400 → Channel Station

Limits of flooding may vary from actual location on the ground.



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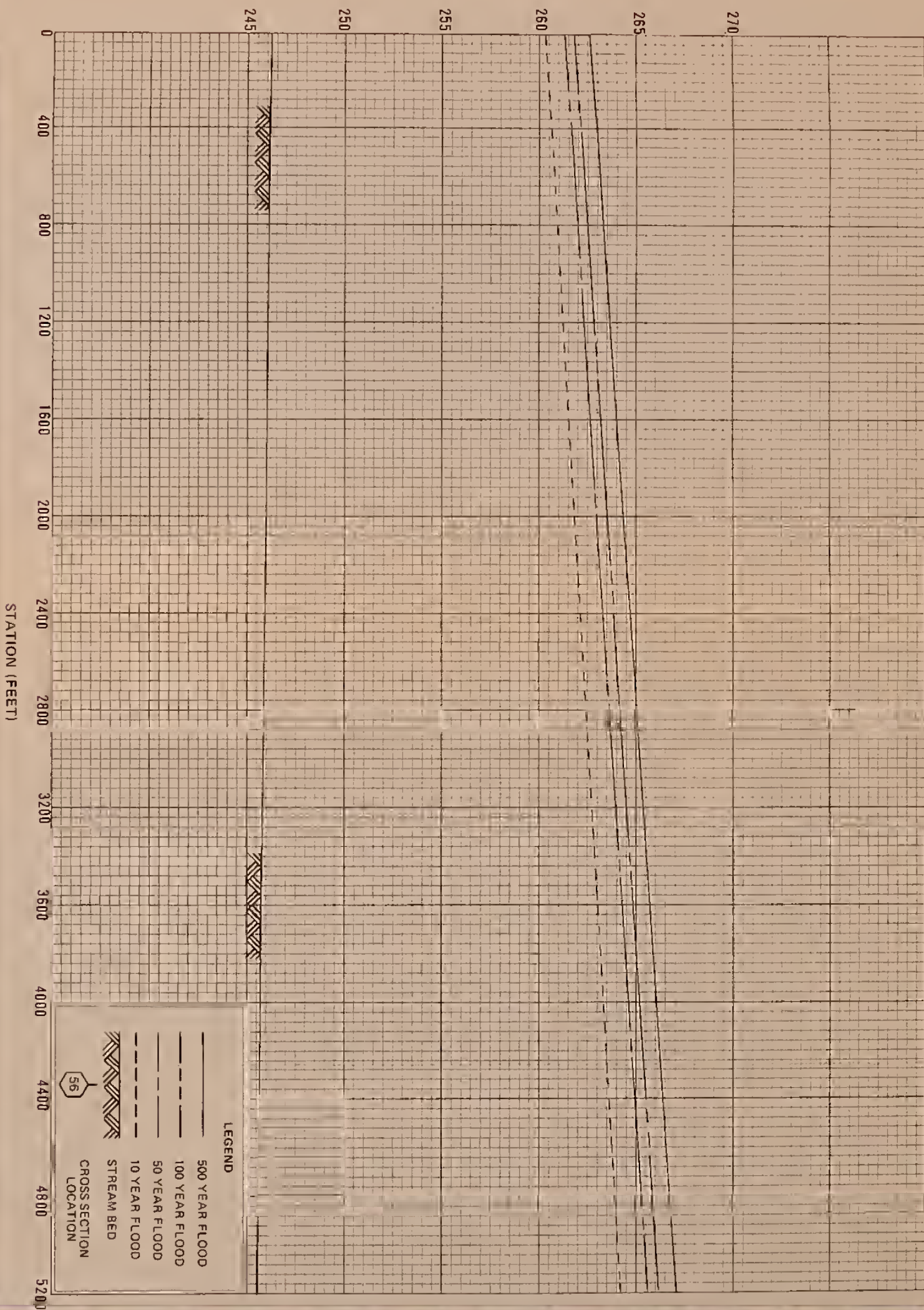
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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

FLOOD HAZARD AREA

LOST CREEK AND SANDY CREEK

ELEVATION (FT - MSL)



LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

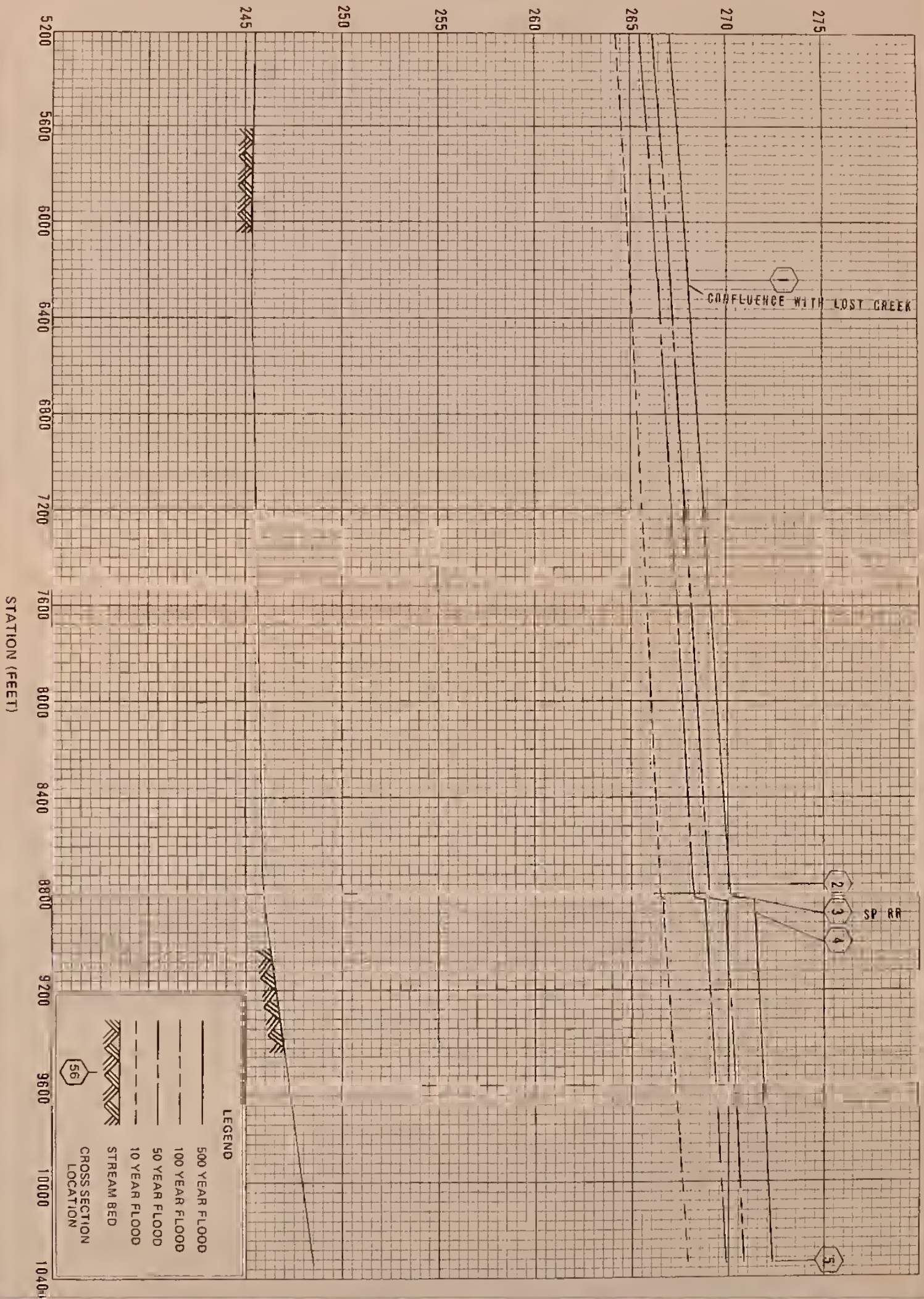
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FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

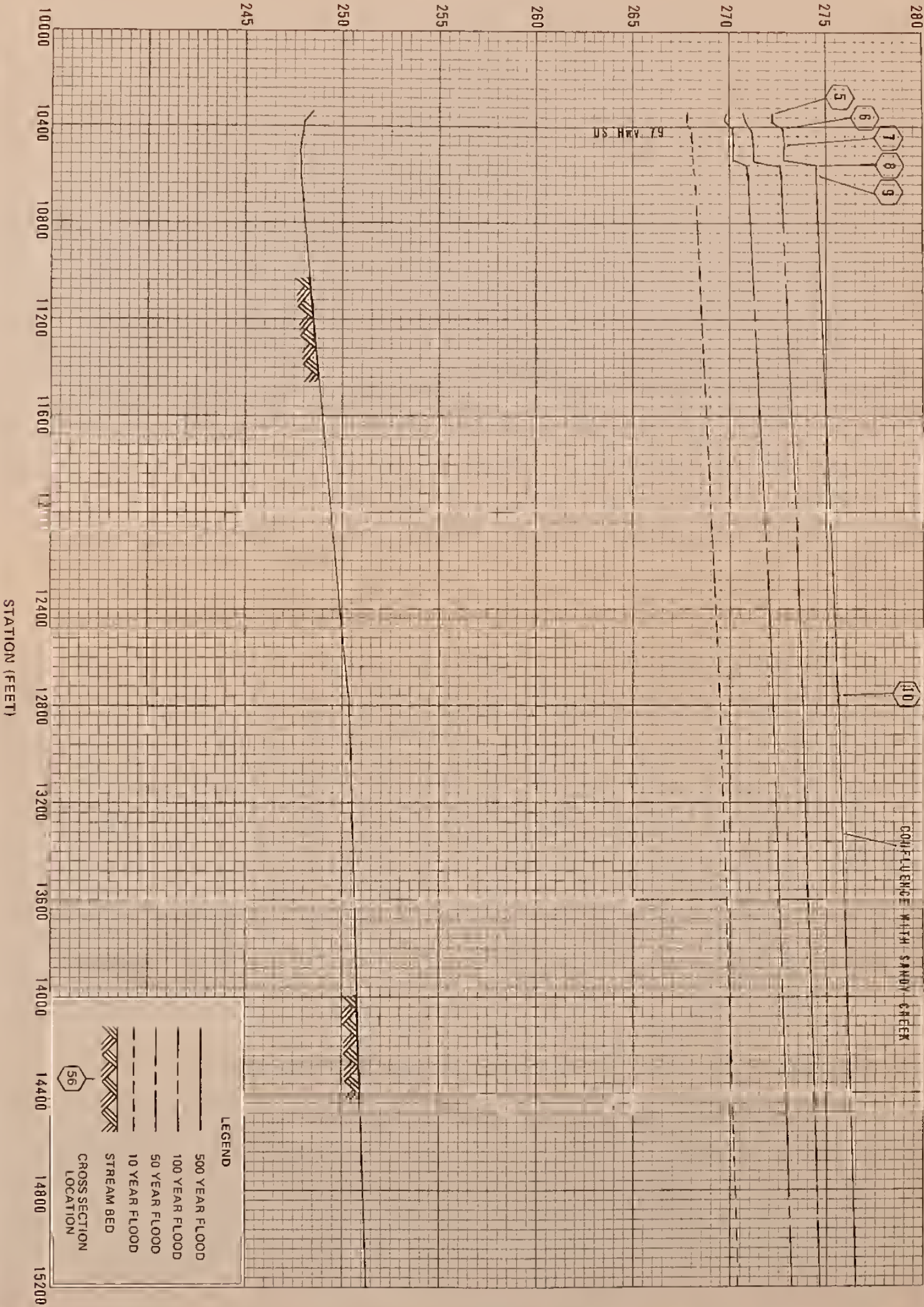
WATER SURFACE PROFILES

LITTLE BRAZOS RIVER

ELEVATION (FT - MSL)



ELEVATION (FT. MSL)



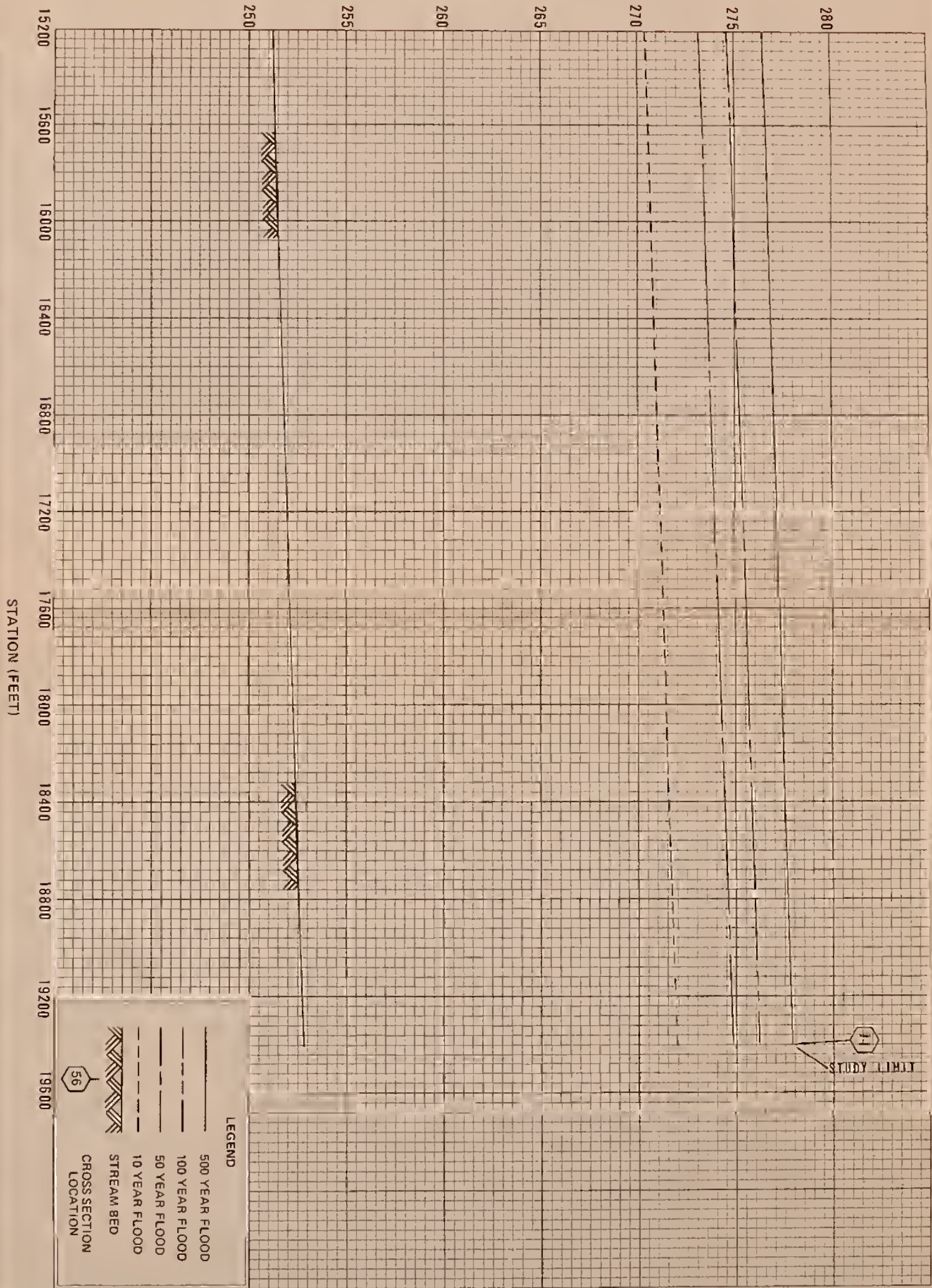
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LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

WATER SURFACE PROFILES

LITTLE BRAZOS RIVER

ELEVATION (FT - MSL)



LEGEND

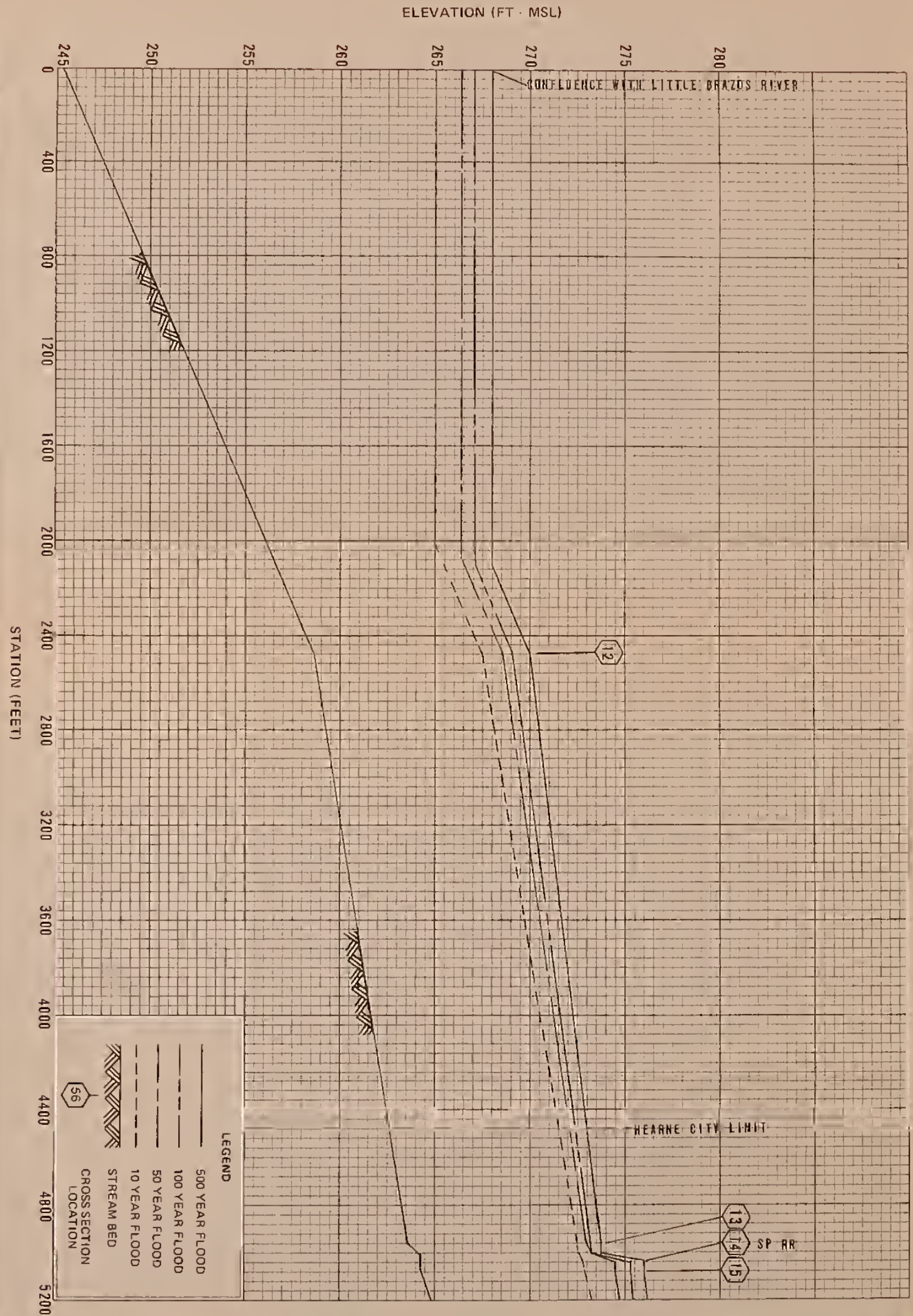
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

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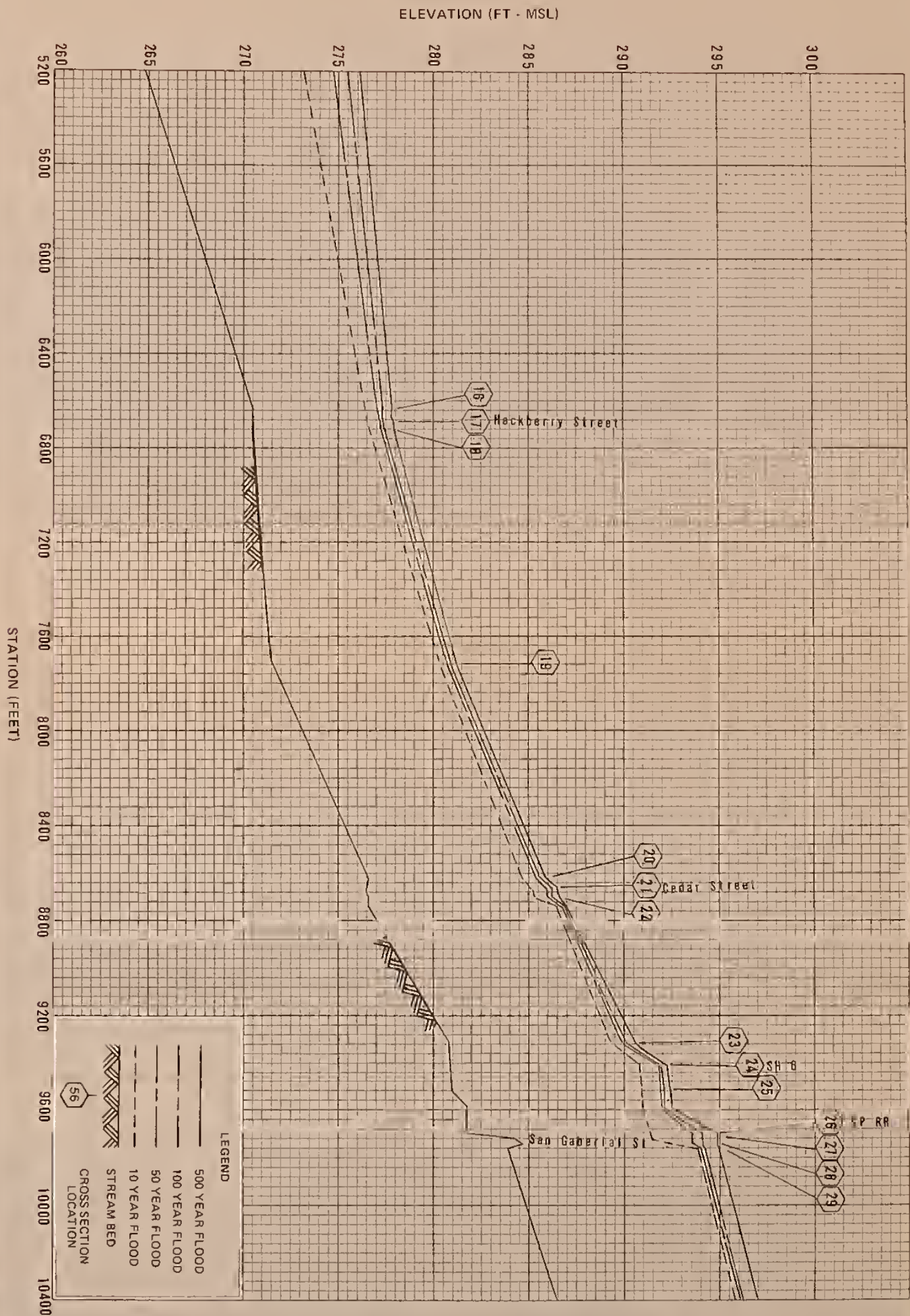
LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

WATER SURFACE PROFILES

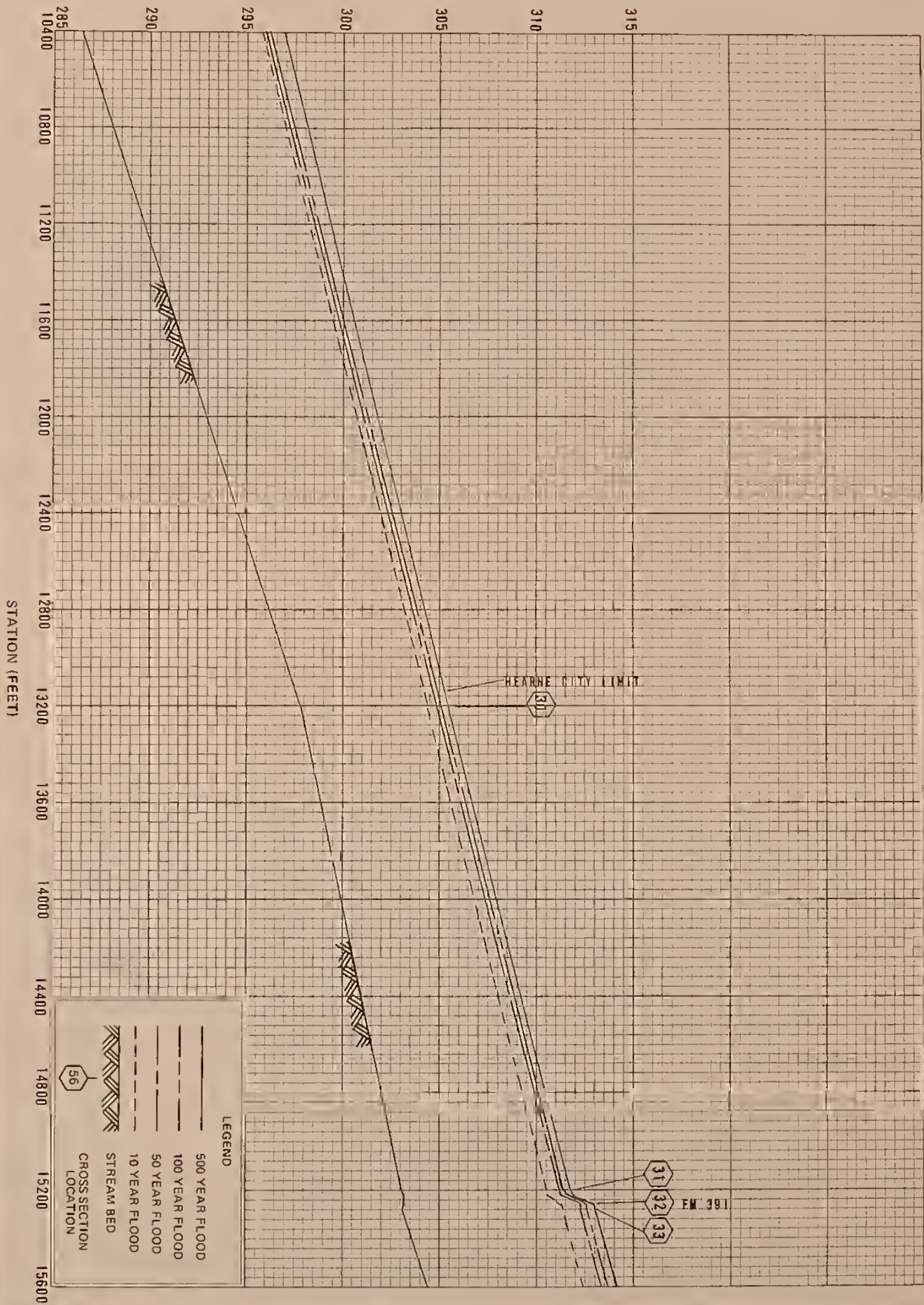
LITTLE BRAZOS RIVER



47



ELEVATION (FT. MSL)

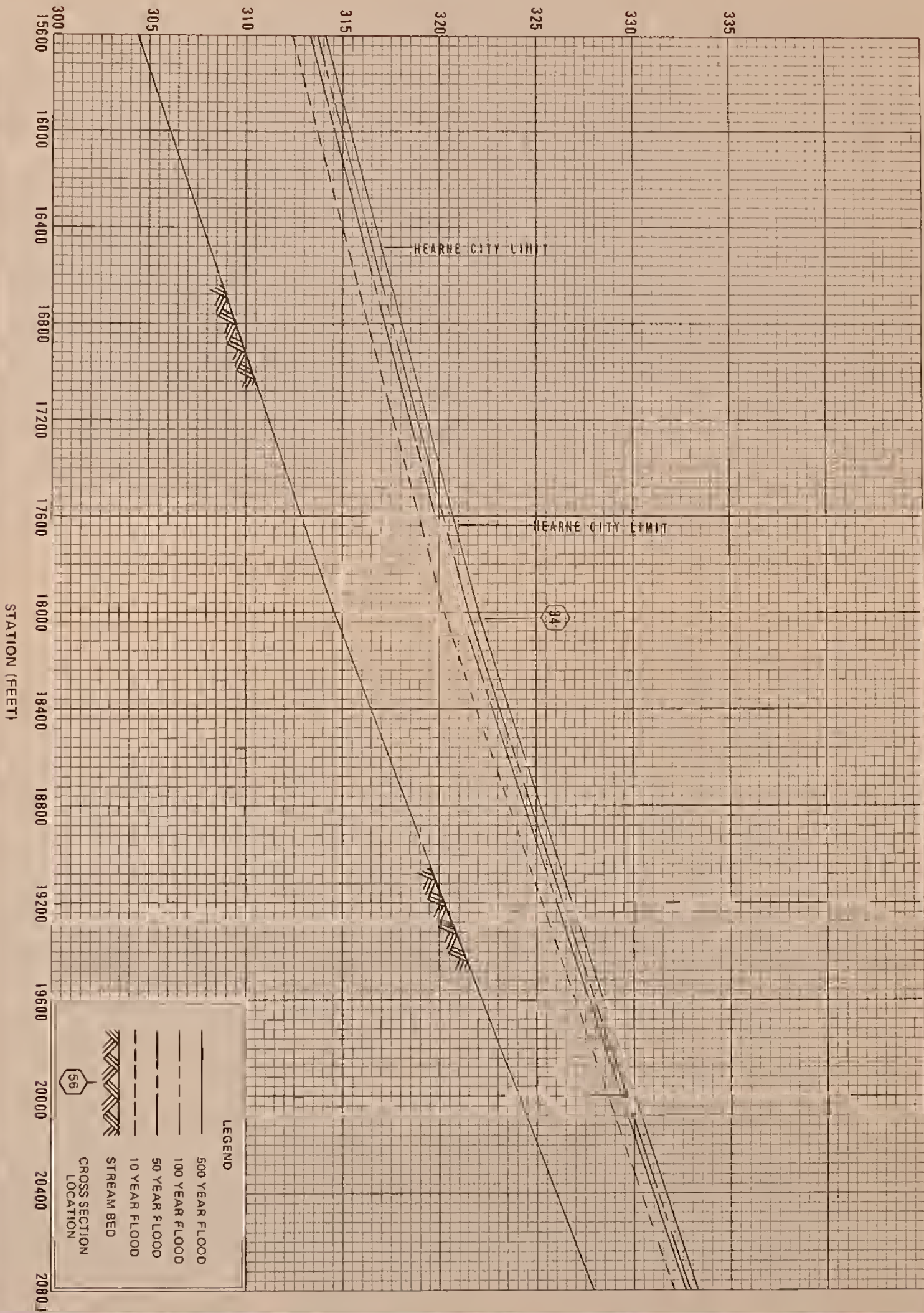


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SOIL CONSERVATION SERVICE
LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

WATER SURFACE PROFILES

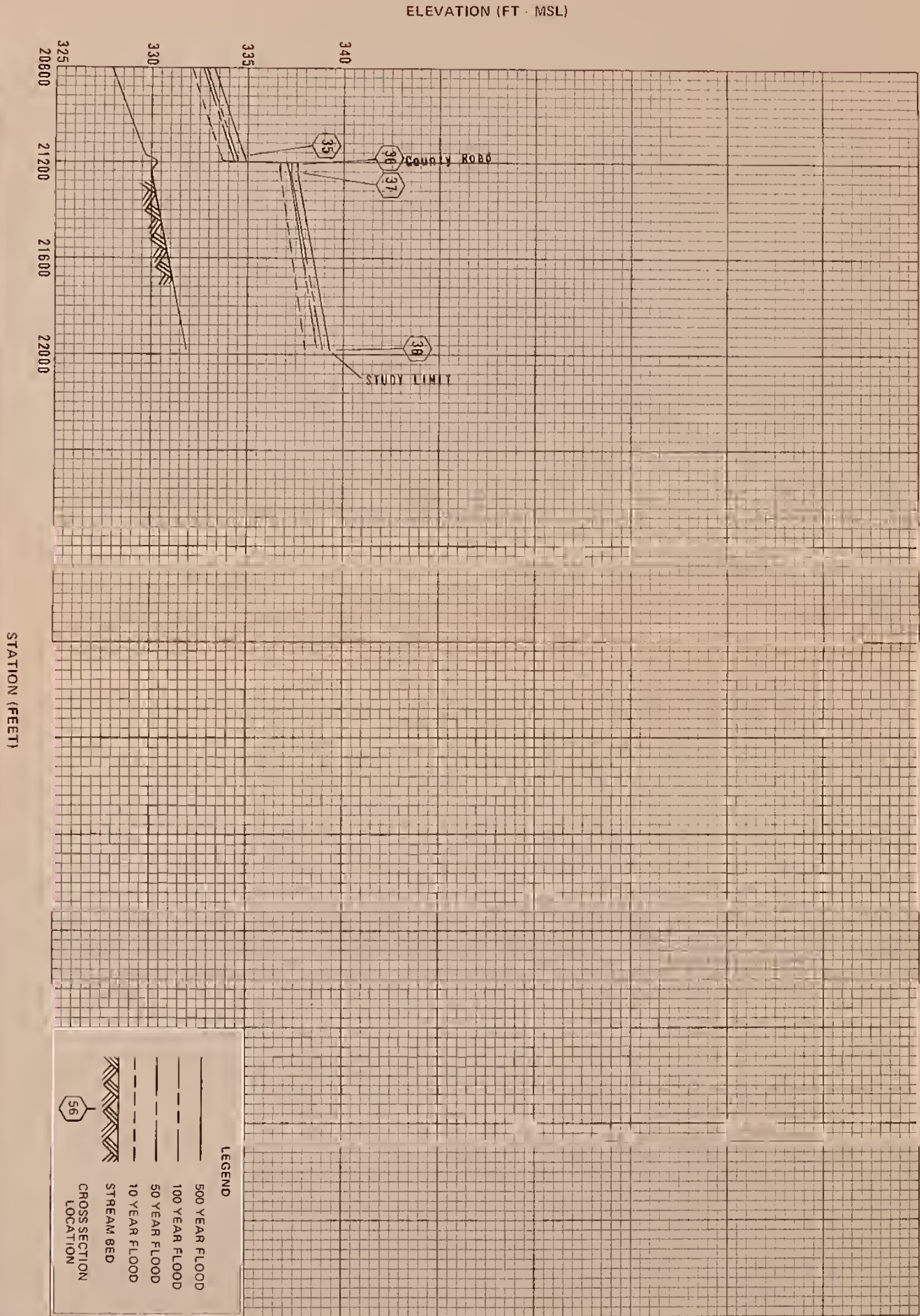
LOST CREEK

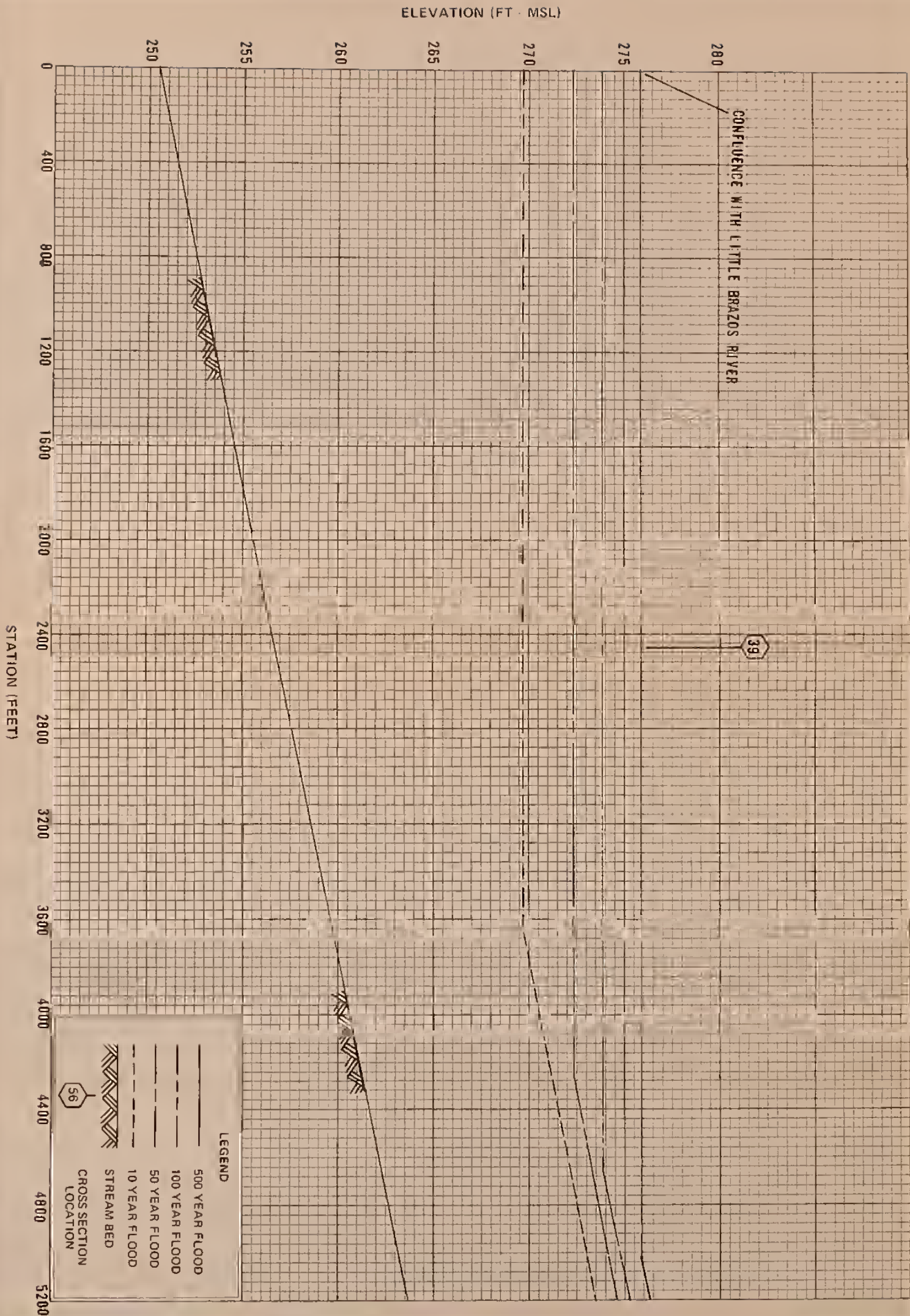
ELEVATION (FT - MSL)



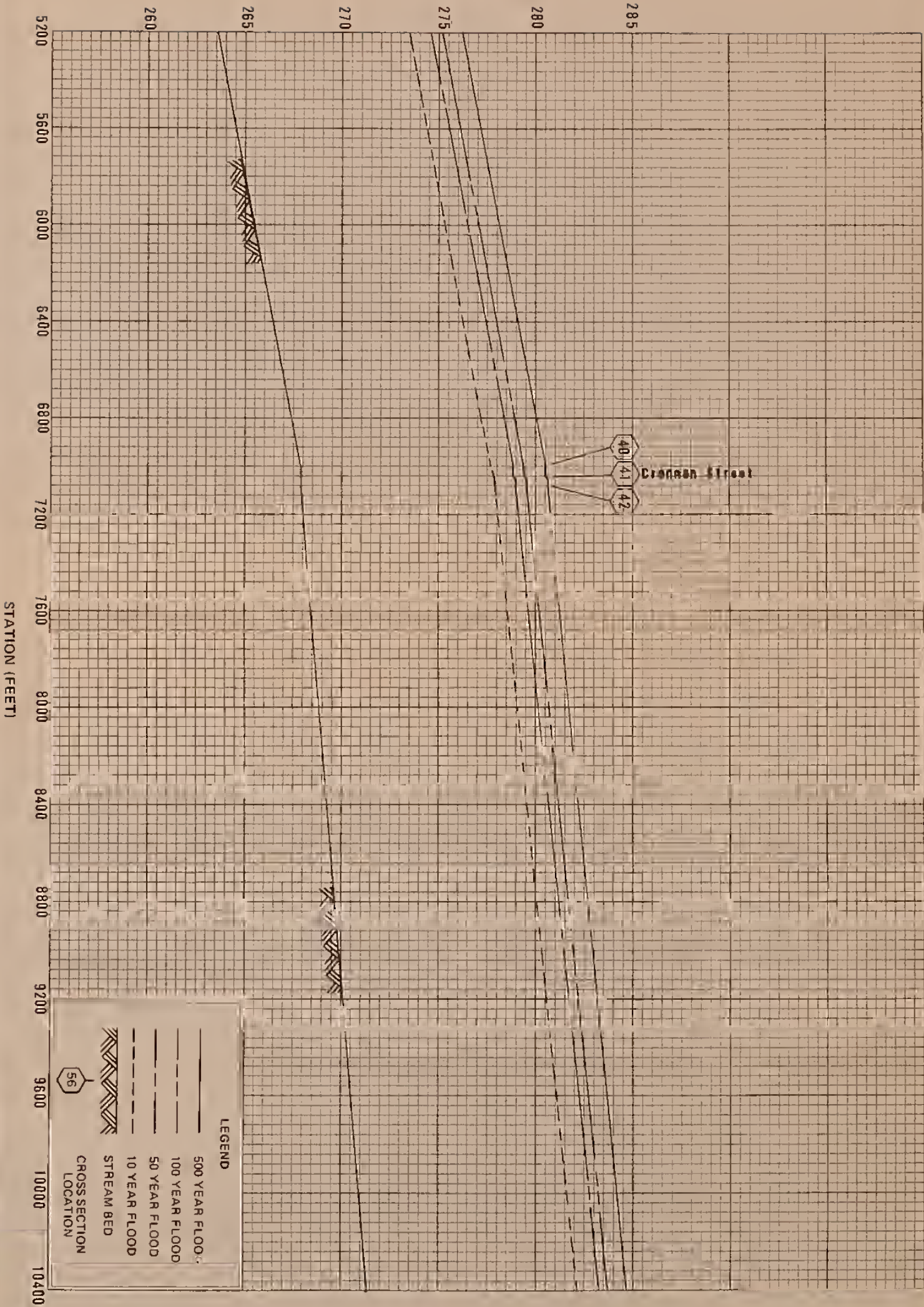
LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION





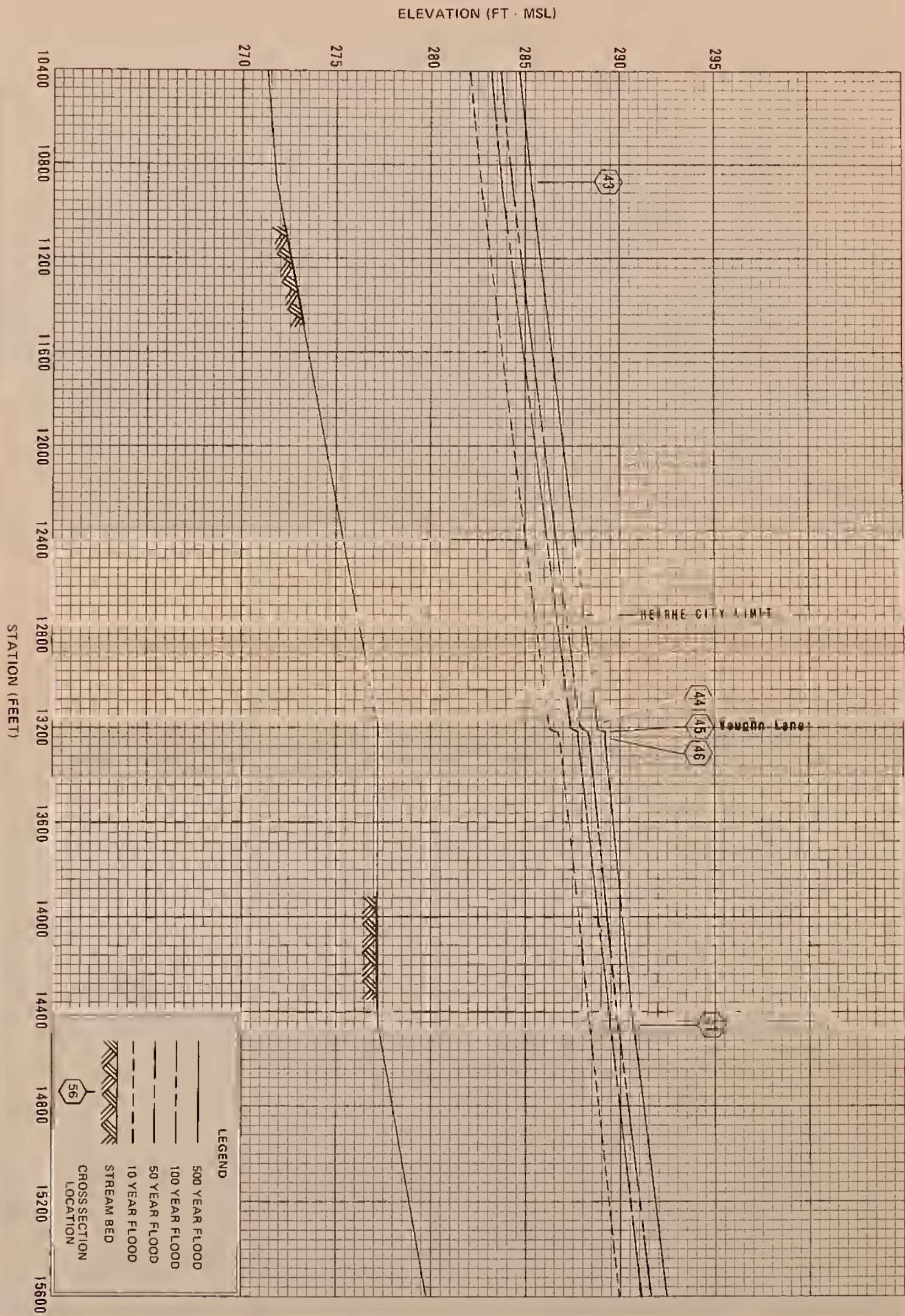
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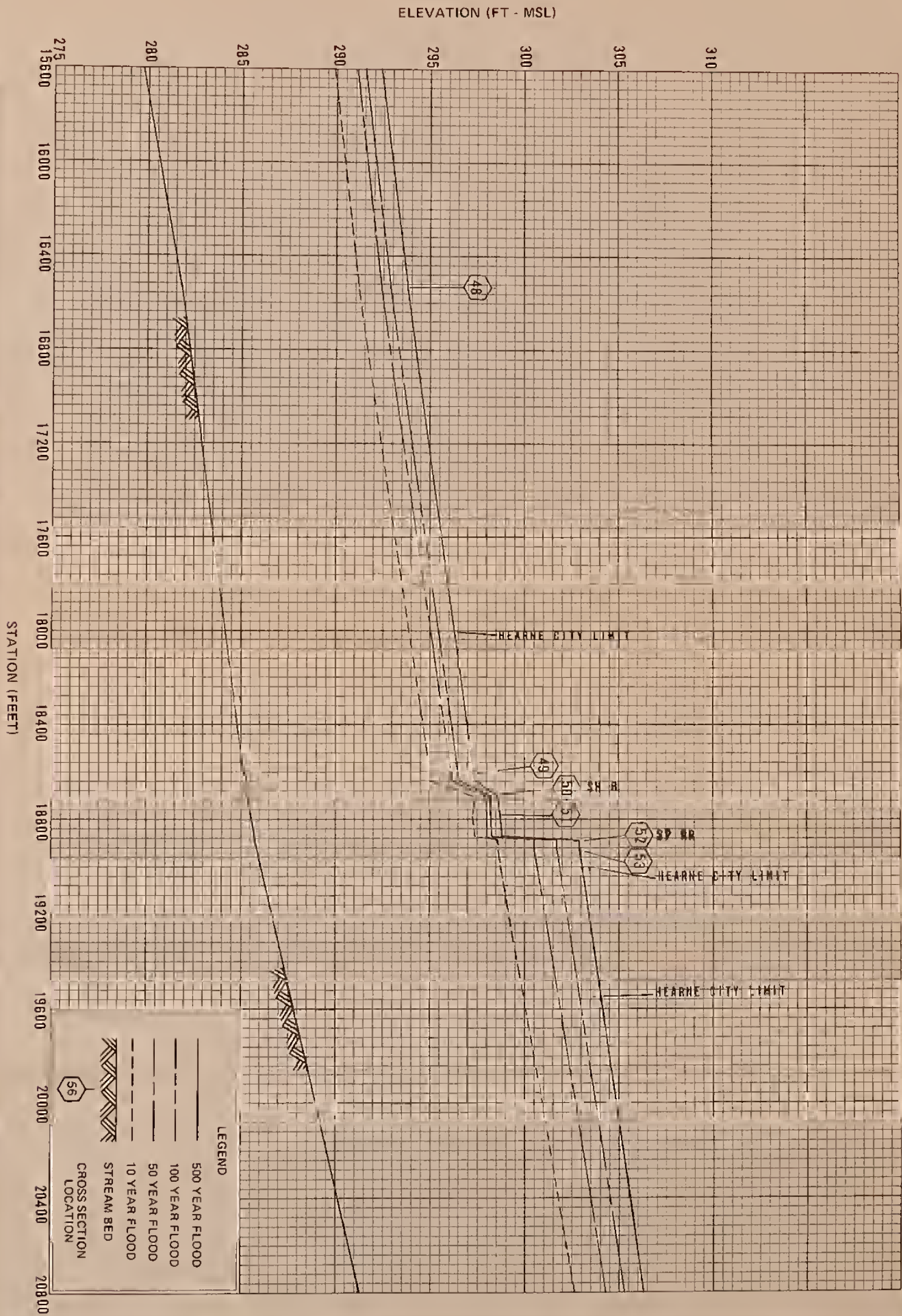


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LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

WATER SURFACE PROFILES

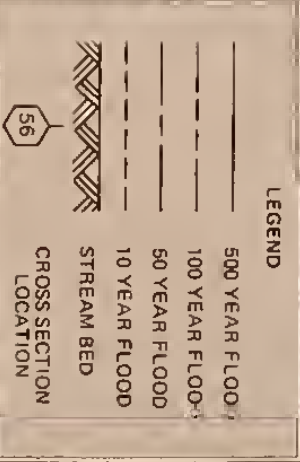
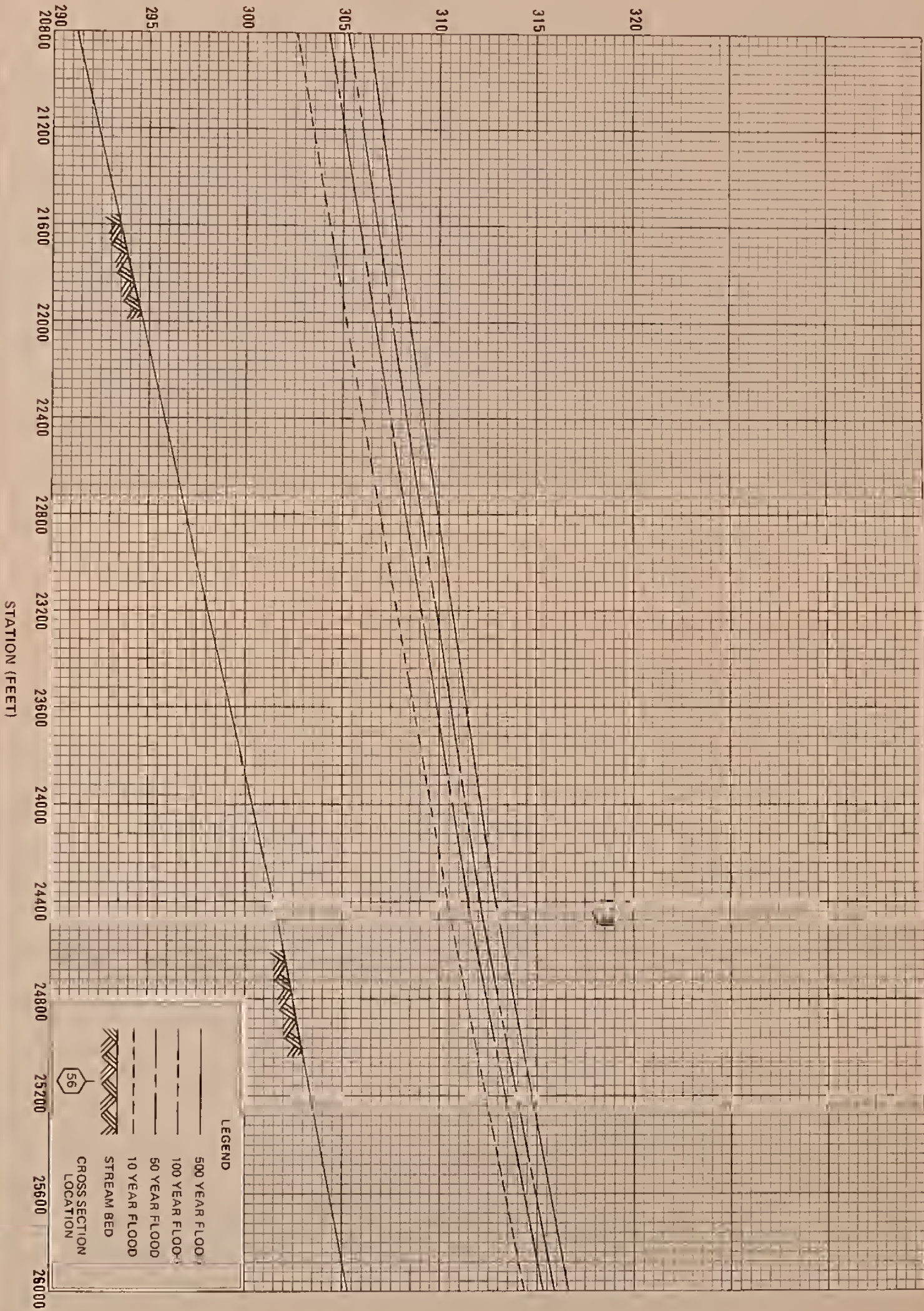
SANDY CREEK



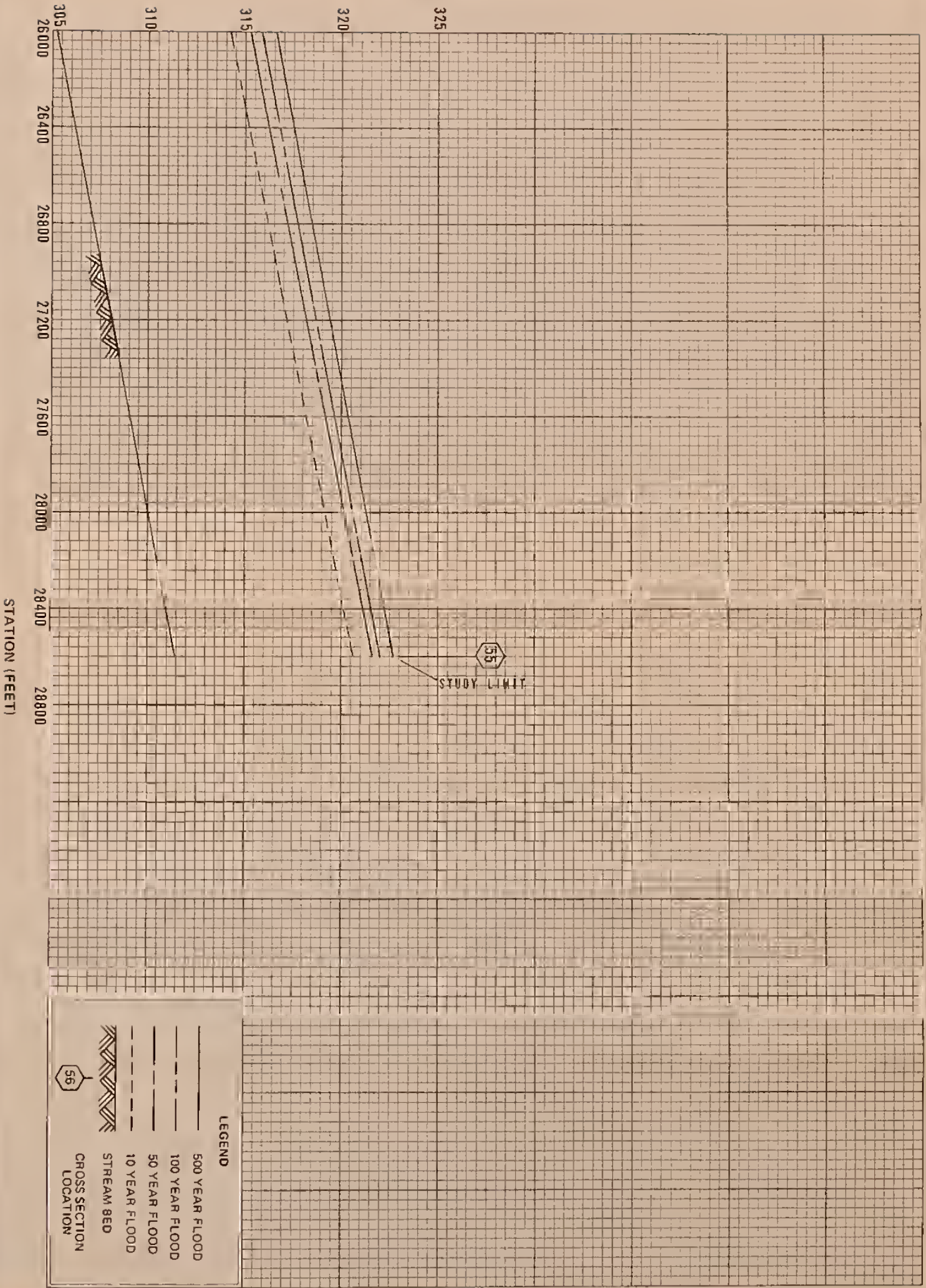


63

ELEVATION (FT - MSL)



ELEVATION (FT - MSL)

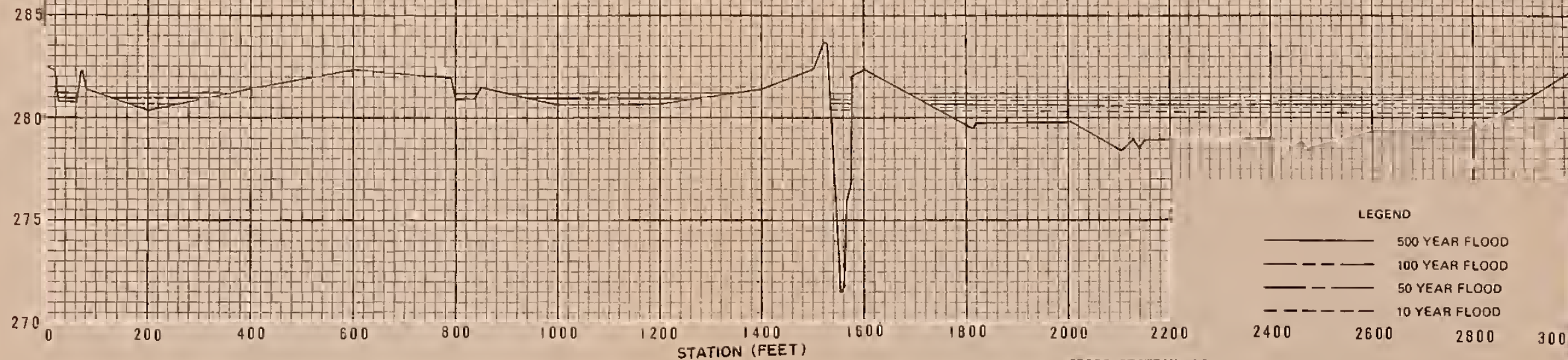


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LOST CREEK AND SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

WATER SURFACE PROFILES

SANDY CREEK

ELEVATION (FT. - MSL)

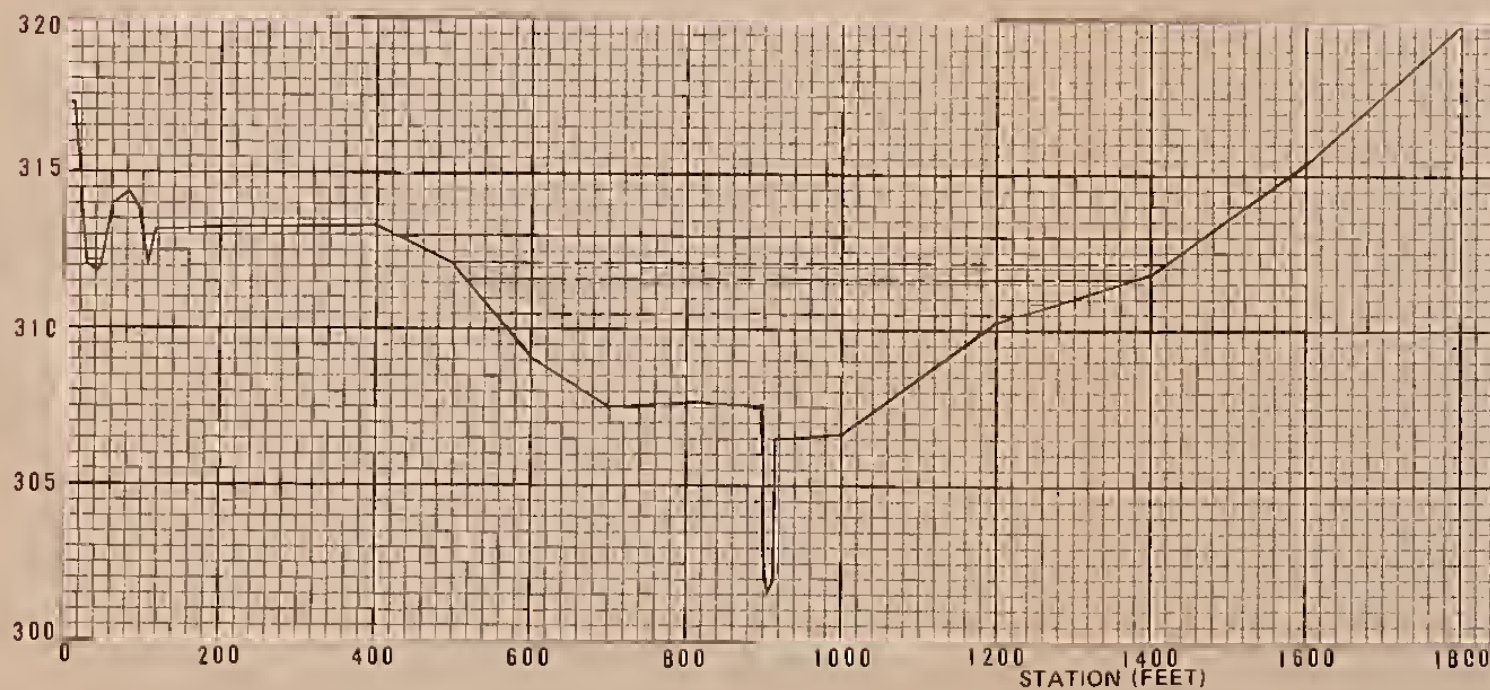


LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD

CROSS SECTION: 19
STREAM: LOST CREEK

ELEVATION (FT.-MSL)



CROSS SECTION: 54
STREAM: SANDY CREEK

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LOST CREEK & SANDY CREEK
FLOOD PLAIN MANAGEMENT STUDY
ROBERTSON COUNTY, TEXAS

TYPICAL VALLEY
CROSS SECTIONS

SHEET 10F1

TABLE 2
LOST CREEK AND SANDY CREEK FLOOD PLAIN MANAGEMENT STUDY
ELEVATION AND DISCHARGE TABULATIONS

CROSS SECTION NUMBER	PRESENT CONDITIONS															
	10-YEAR FREQUENCY				50-YEAR FREQUENCY				100-YEAR FREQUENCY				500-YEAR FREQUENCY			
	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	1/ DISCHARGE CFS	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	1/ DISCHARGE CFS	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	1/ DISCHARGE CFS	DISCHARGE CFS	ELEVATION M.S.L. FEET	FLOOD PLAIN WIDTH FEET	
LITTLE BRAZOS RIVER																
1	17929	265.0	650	28438	266.4	682	34900	267.1	698	268.0	715*					
2	17943	266.5	688	28453	268.2	728	34922	269.0	747	270.1	773					
3	17943	266.7	285	28453	268.8	285	34922	269.9	285	271.4	286					
4	17943	266.7	570	28453	268.9	623	34922	269.9	647	271.4	694					
5	17950	267.9	774	28460	269.9	807	34936	270.8	821	272.3	846					
6	17950	268.0	533	28460	270.2	537	34936	271.2	538	272.8	541					
7	17950	268.1	673	28460	270.3	739	34936	271.3	788	272.9	879					
8	17950	268.1	524	28460	270.9	531	34936	272.6	532	274.5	963					
9	17950	268.2	676	28460	271.0	771	34936	272.6	862	274.5	1015					
10	17966	269.5	393	28479	272.2	518	34972	273.7	1773	275.7	2441*					
11	17980	271.9	755	28458	274.8	1332	34871	276.2	4129	277.8	4353*					

1/ Left flood plain only.

* Indicates island flow in the flood plain.

TABLE 2
LOST CREEK AND SANDY CREEK FLOOD PLAIN MANAGEMENT STUDY
ELEVATION AND DISCHARGE TABULATIONS

CROSS SECTION NUMBER	PRESENT CONDITIONS											
	10-YEAR FREQUENCY				50-YEAR FREQUENCY				100-YEAR FREQUENCY			
	DISCHARGE		ELEVATION		DISCHARGE		ELEVATION		DISCHARGE		ELEVATION	
	CFS	FEET	M.S.L.	FEET	CFS	FEET	M.S.L.	FEET	CFS	FEET	M.S.L.	FEET
		FLOOD PLAIN WIDTH FEET		FLOOD PLAIN WIDTH FEET		FLOOD PLAIN WIDTH FEET		FLOOD PLAIN WIDTH FEET		FLOOD PLAIN WIDTH FEET		FLOOD PLAIN WIDTH FEET
LOST CREEK												
12	1645	267.5	1000	2478	268.6	1154	2903	269.1	1239	3746	270.0	1400
13	1837	272.5	1400	2725	273.0	1553	3165	273.2	1605	4069	273.7	1733*
14	1837	272.8	104	2725	274.5	104	3165	275.3	105	4069	276.0	105
15	1837	272.9	1061	2725	274.5	2262	3165	275.3	2680	4069	276.0	2762*
16	2018	276.4	3379	2956	277.0	3646	3406	277.3	3672	4366	277.8	3822*
17	2018	276.5	3603	2956	277.2	3728	3406	277.4	3739	4366	277.9	3819*
18	2018	276.6	3717	2956	277.2	3740	3406	277.4	3749	4366	277.9	3809*
19	2005	280.3	1341	2978	280.7	1367	3443	280.9	2889	4438	281.2	2909*
20	1993	284.7	1212	2998	285.4	1559	3479	285.6	1686	4507	285.9	1877*
21	1993	285.3	1350	2998	286.0	1966	3479	286.2	2056	4507	286.6	2213*
22	1993	286.5	1889	2998	286.8	1938	3479	286.9	1953	4507	287.0	1967*
23	1982	289.3	708	3018	289.9	771	3512	290.1	827	4573	290.6	921*
24	1982	290.8	35	3018	291.8	883	3512	291.9	966	4573	292.2	1217
25	1982	290.9	676	3018	291.9	1454	3512	292.1	1519	4573	292.4	1616
26	1982	291.4	74	3018	293.6	75	3512	294.1	75	4573	294.9	266*
27	1982	291.4	133	3018	293.6	1108	3512	294.1	1317	4573	294.9	1446*
28	1982	292.5	1121	3018	293.6	1488	3512	294.1	1600	4573	294.9	1969
29	1982	293.8	1225	3018	294.0	1297	3512	294.2	1766	4573	295.0	2350
30	1422	304.4	576	2131	304.9	647	2501	305.1	677	3251	305.4	720
31	1110	310.5	287	1644	311.2	335	1941	311.4	346	2521	311.8	370
32	1110	311.3	54	1644	312.3	270	1941	312.6	304	2521	313.0	350
33	1110	311.4	301	1644	312.3	373	1941	312.6	393	2521	313.0	419

* Indicates island flow in the flood plain.

TABLE 2

* Indicates island flow in the flood plain.

2/ Inundated by Little Brazos River

TABLE 3

BENCH MARK DESCRIPTIONS AND ELEVATIONS

FLOOD PLAIN MANAGEMENT STUDY

LOST CREEK AND SANDY CREEK

ROBERTSON COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
1	RM 13	280.61	A railroad spike driven 1 foot above the ground in the southwest side of the east pole of an electric transmission line approximately 1,700 feet southeast of the end of a gravel road that intersects SH 6 at the north side of the Texas Pipeline Company pumping station southeast of Hearne.
1	RM 21	281.81	A bent 60-d nail driven in the root on the south side of a 24 inch hackberry tree, 400 feet northwest along an electric transmission line from the point where it changes direction to the southeast and 130 feet east of center of an electric line and 60 feet east of an abandoned haul road.
2	RM 5	273.90	A chiseled square on the southeast corner of the concrete slab of a sewage lift station. 70 feet southeast of the centerline of the Southern Pacific Railroad and 90 feet west of the centerline of Lost Creek.
3	RM 49	277.21	A square cut in the top of a concrete wingwall on the north west corner of bridge on Hackberry Street on Lost Creek. "□" is 2 feet along wingwall on culvert deck.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST AND SANDY CREEK
ROBERTSON COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MS)	Description
3	RM 52	282.75	"□" cut in the center of the top of a storm drain inlet on the south side of U.S. Highway 79, 30 feet east of the centerline of Willow Street.
3	RM 53	286.19	"□" cut in the center of the top of a storm drain inlet on the north side of U.S. Highway 79, 30 feet east of the centerline of Post Oak Street.
3	RM 54	289.82	"□" cut in the center of the top of a storm drain inlet in the southwest curb return at the intersection of Highway 6 and U.S. Highway 79.
3	RM 62	287.99	A square cut on the center of a concrete headwall of culvert on the west side of Highway 6, 300 feet south of the overpass over the Southern Pacific Railroad.
4	RM 56	310.99	"□" cut on the northeast corner of the concrete deck of FM 391 bridge across Lost Creek.
5	RM 57	346.11	Railroad spike 1 foot above ground in a power pole on the south side of the gravel road that is adjacent to the north side of Hearne Cemetery. 0.2 mile east along the road from the northeast corner of the cemetery 25 feet west of a 90 degree turn in the road.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY, TEXAS

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
5	RM 58	365.11	Railroad spike 2 feet above ground driven in a power pole on the north side of a county road 1200 feet west of Lost Creek, 15 feet north of a fence and 100 feet west of a driveway on the north side of the road. 0.9 mile upstream along Lost Creek from FM 391.
5	TM 59	366.04	Railroad spike 3 feet above ground in a power pole 50 feet north of centerline of county road and 200 feet west of the intersection with a road to the north. 0.9 mile north of FM 391.
6	RM 7	264.43	A railroad spike driven 1 foot above the ground in the south side of a wooden pier on the southeast side of the Southern Pacific Railroad bridge across the main channel of the Little Brazos River, and in the first bent of piers from the southwest end of the bridge.
6	RM 8	271.23	The top of a bolt in the top of the south end of the pier cap at the southwest abutment of the Southern Pacific Railroad bridge across the Little Brazos River overflow channel.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
6	RM 9	269.82	The top of the threaded end of a bolt on the northeast corner of a railroad signal base on the south side of the Southern Pacific Railroad, 20 feet south of the track and 75 feet east of the centerline of FM 50.
6	RM 18	256.31	A railroad spike driven 2 feet above the ground in the north side of an 18 inch elm tree on the west bank of the Little Brazos River, 60 feet west of the centerline of the river and 0.5 mile south along the Little Brazos River from the Southern Pacific Railroad.
6	RM 19	259.03	A railroad spike driven 2 feet above the ground in the north side of a 24 inch elm tree on the east bank of the Little Brazos River, 60 feet east of the centerline of the river and 0.5 mile south along the Little Brazos River from the Southern Pacific Railroad.
7	RM 6	265.50	A railroad spike driven 1 foot above the ground in the south side of a wooden pier on the southeast side of the Southern Pacific Railroad bridge across the main channel of the Little Brazos River, and in the second bent of piers from the northeast end of the bridge.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
7	RM 7	264.43	A railroad spike driven 1 foot above the ground in the south side of a wooden pier on the southeast side of the Southern Pacific Railroad bridge across the main channel of the Little Brazos River, and in the first bent of piers from the southwest end of the bridge.
7	RM 8	271.23	The top of a bolt in the top of the south end of the pier cap at the southwest abutment of the Southern Pacific Railroad bridge across the Little Brazos River overflow channel.
7	RM 22	276.07	A railroad spike driven 1 foot above the ground in the north side of a power pole on the east side of the Missouri and Pacific Railroad 1,250 feet southwest along the railroad from RM 11.
8	RM 11	272.05	"□" chiseled on the top of the northwest corner of a concrete headwall of a box culvert on the north side of U.S. Highway 79, 50 feet west and 40 feet north of the end of the center median curb of Highway 79 and 0.6 mile east along Highway 79 from the east end of the Little Brazos River bridge.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
8	RM 23	276.48	A railroad spike driven 1 foot above the ground in the south side of the center pole of an electric power transmission line support, approximately 0.3 mile east of the taxi way of Hearne Municipal Airport and 550 feet northwest along a fence line from a corner and 250 feet northeast of the fence.
8	RM 51	275.63	"□" cut in deck of west end of concrete culvert (no headwall). 30 feet west of the centerline of Hackberry Street and 60 feet south of the centerline of U.S. Highway 79.
8	RM 52	282.75	"□" cut in the center of the top of a storm drain inlet on the south side of U.S. Highway 79, 30 feet east of the centerline of Willow Street.
9	RM 31	289.84	A railroad spike driven 1 foot above the ground in the southwest side of a power pole on the northeast side of Crennan Street at the intersection with Milton Street.
9	RM 32	293.46	A railroad spike driven 2 feet above the ground in the southwest side of a power pole 100 feet northwest of a fence and 0.25 mile northwest of the intersection of Crennan and Milton Streets.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
9	RM 36	284.78	"□" chiseled in the top of an old concrete pier on the north-west side of the landfill road bridge across Sandy Creek, on the northeast side of Sandy Creek.
9	RM 37	298.40	A railroad spike 1.0 foot above the ground driven in the south side of a power pole, on the northwest corner of the intersection of West Tenth Street and road to Hearne landfill.
9	RM 38	292.74	"□" chiseled on the top of the center of the curb return, on the northeast corner of the intersection of West Eighth Street and Colorado Street.
9	RM 39	294.69	"□" chiseled on the top of the center of the curb return on the northwest corner of the intersection of West Seventh Street and Navasota Street.
9	RM 40	296.62	Bent 60-d nail in 12 inch oak tree, 580 feet southeast of fenceline and 1,375 feet north-west of the northwest end of Navasota Street.
9	RM 42	293.96	"□" cut in the center of top of storm drain inlet on the east side of Milam Street, 25 feet north of the centerline of West Eight Street.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
9	RM 43	303.84	"□" cut in the top of the curb on the west side of Highway 6, at the north end of the curb return, on the northwest corner of the intersection of Highway 6 and West Ninth Street.
10	RM 41	300.85	Bent 60-d nail in 18 inch oak tree, 1 foot above the ground, 1,600 feet northwest of the northwest end of Milam Street and 350 feet south-east of a fenceline.
10	RM 44	296.45	"□" chiseled on the southwest corner of bridge abutment of Highway 6 bridge across Sandy Creek.
11	RM 47	313.41	"□" cut in the center of a concrete headwall of culvert on the south side of U.S. Highway 79 (old) 300 feet west of the west most driveway to a white brick house on the north side of U.S. Highway 79. 1.2 miles south along Highway 79 from intersection with U.S. Highway 79 bypass.
12	RM 48	333.11	Bent 60-d nail in the east side of a 30 inch oak tree 2 feet above ground, on the west side of U.S. Highway 79 (old) and on the north side of the entrance to a mobile home and 0.5 mile south along Highway 79 from the intersection with U. S. Highway 79 bypass.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
12	BM 5	338.38	A standard USC&GS monument, stamped "P 197 1933", set in the top of the northeast corner of a concrete head-wall of a culvert on the Missouri and Pacific Railroad 2.2 miles along the Missouri and Pacific Railroad northeast from Hearne.
13	RM 27	266.02	A railroad spike driven 1.5 feet above the ground in an 18 inch elm tree on the north bank of the Little Brazos River, 55 feet north of the river bank and 75 feet upstream from a concrete low water crossing, 0.7 mile southwest of the south end of the runway of Hearne Municipal Airport.
13	RM 28	262.70	A railroad spike in the root of a 36 inch willow tree on the south bank of the Little Brazos River and on the east side of a concrete low water crossing 0.7 mile southwest of the south end of the runway of Hearne Municipal Airport.
14	RM 25	279.23	A masonry nail in the center of a 1½ inch metal disk driven 5.0 feet east of the west edge of the main runway of Hearne Municipal Airport and in line with the centerline of Crennan Street projected to intersect the west edge of the runway.

TABLE 3
BENCH MARK DESCRIPTIONS AND ELEVATIONS
FLOOD PLAIN MANAGEMENT STUDY
LOST CREEK AND SANDY CREEK
ROBERTSON COUNTY

Flood Hazard Area Sheet Number	RM Name	Elevation (Ft. MSL)	Description
14	RM 30	278.29	"□" chiseled in the concrete floor at the center of the doors of the first metal hanger building on the southeast corner of the intersection of Crennan Street and the taxi way of Hearne Municipal Airport.
15	RM 32	293.46	A railroad spike driven 2 feet above the ground in the southwest side of a power pole 100 feet northwest of a fence and 0.25 mile northwest of the intersection of Crennan and Milton Streets.
15	RM 34	294.55	"□" chiseled on the the northeast corner of a concrete wall of a cattle guard across the road from Hearne Municipal Airport to FM 485, approximately 80 feet east of a 90 degree turn in the road and 0.3 feet northeast of the north end of the airport runway.



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